AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

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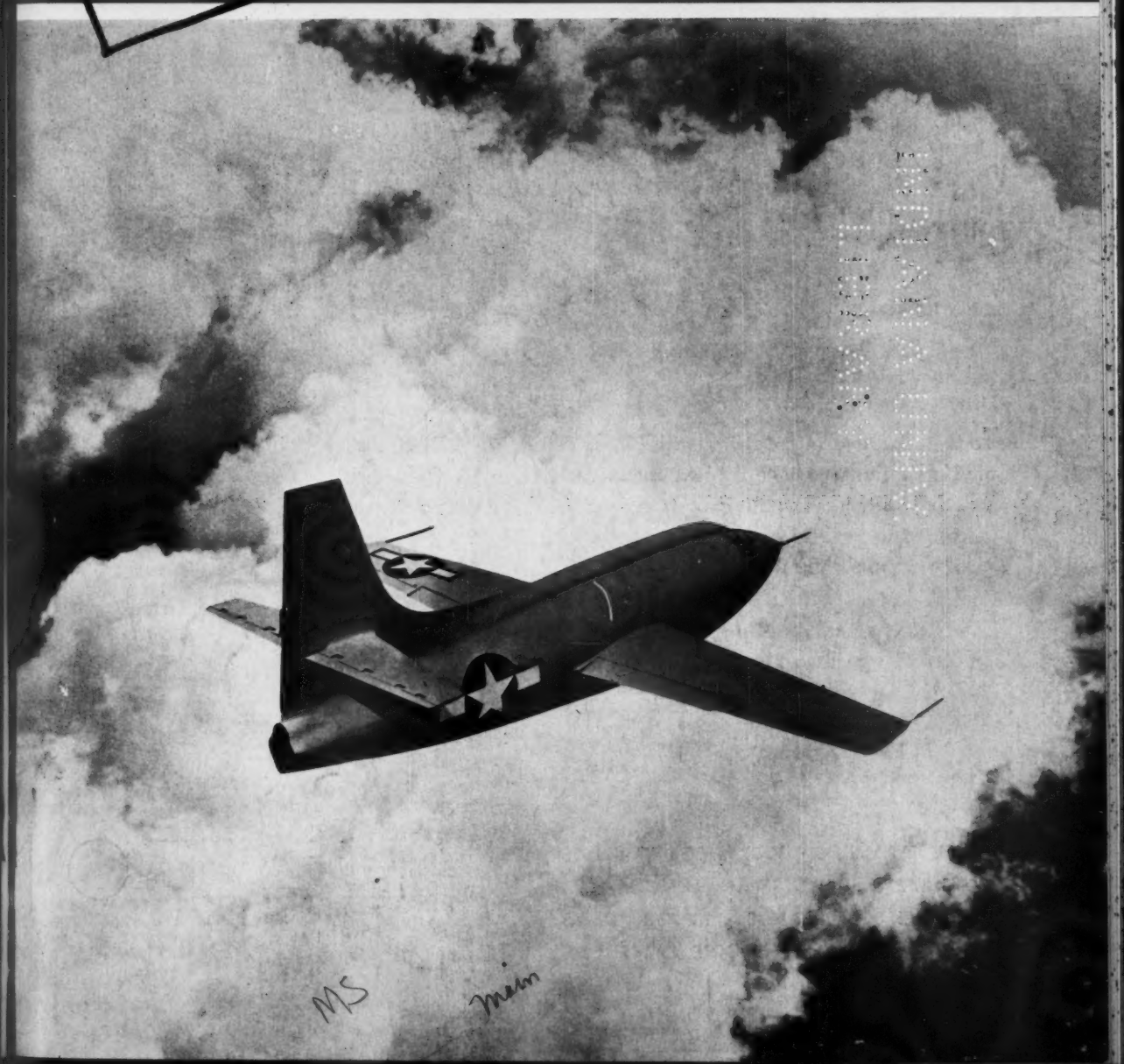

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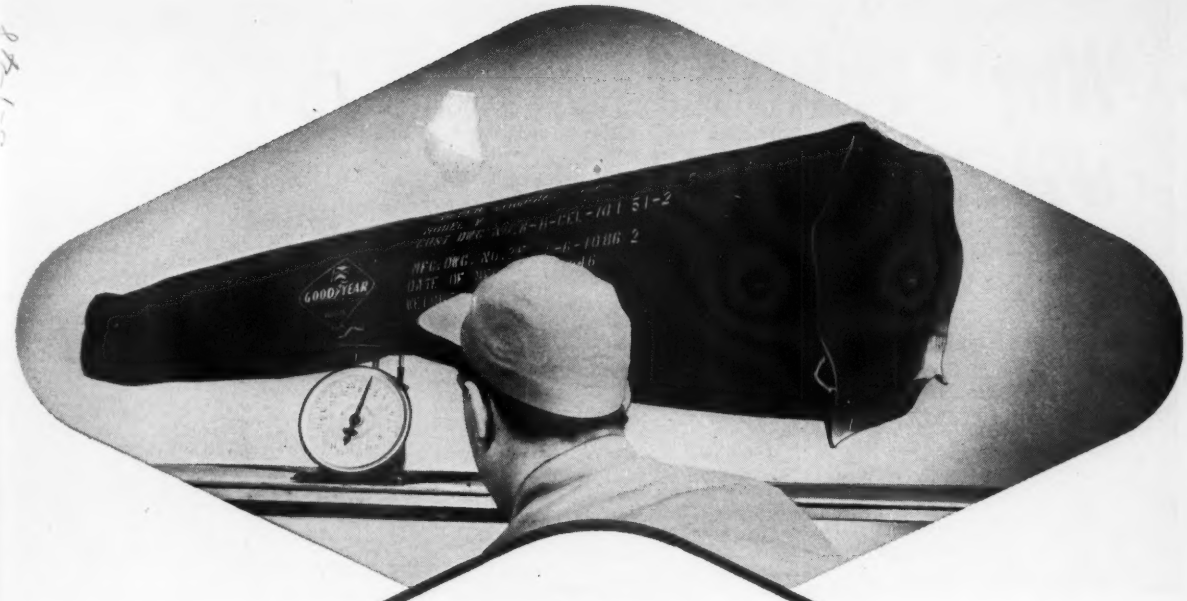

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(Above) Showing the Monel (Bundy) Tubing used in the primer tube assembly in Wright Aircraft engines. These tubes are among the many Inco Nickel Alloy products now standard with leading aircraft companies.

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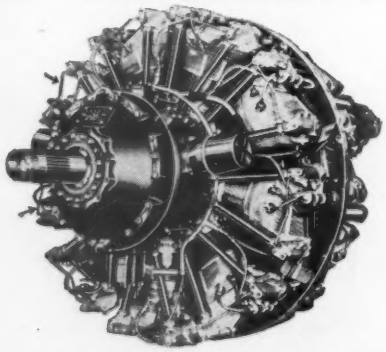

2500-hp. Wright Cyclone aircraft engine. This engine employs Monel tubing to inject fuel into cylinders and for the drain valve which eliminates condensed atmospheric moisture from the induction chamber each time engine finishes a flight. Photo courtesy of Wright Aeronautical Corporation, Woodridge, N. J.

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Cover—Bell XS-1 in Flight.

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AERONAUTICAL ENGINEERING REVIEW

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MAIN

ELECTROL'S
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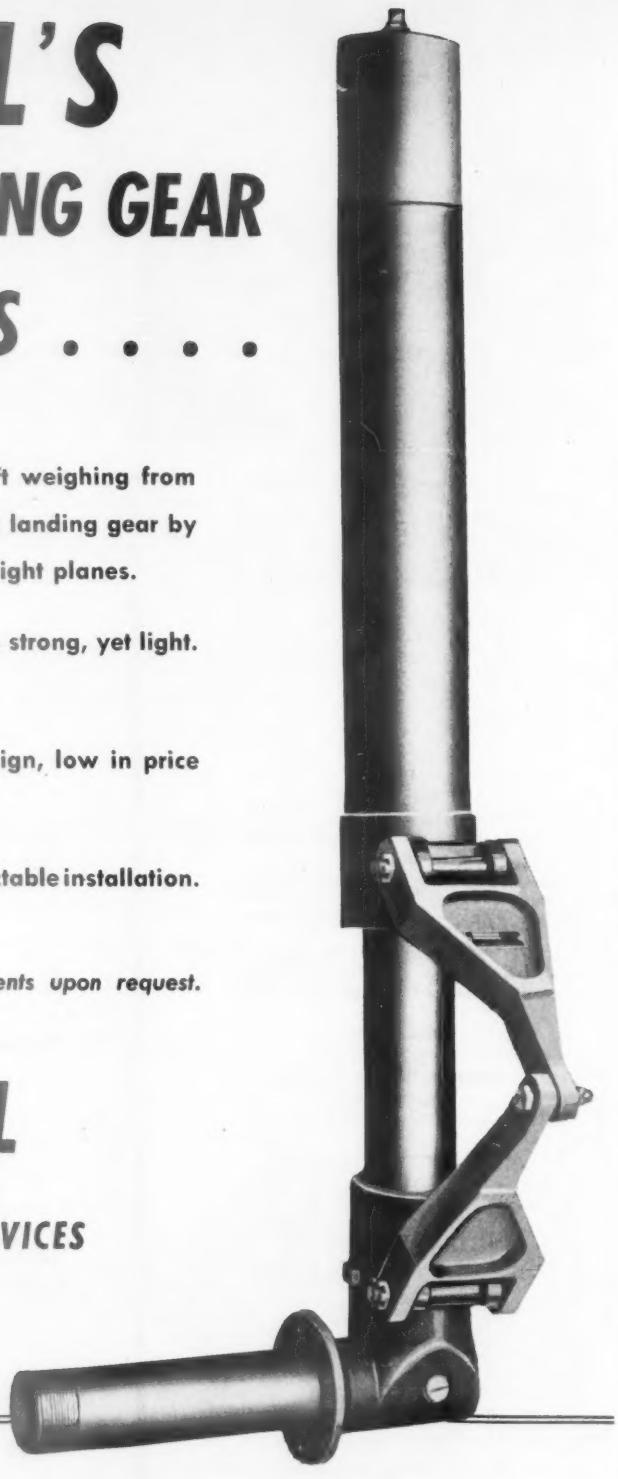

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I.A.S. News

A Record of People and Events of Interest to Institute Members

Straight Appointed I.A.S. Western Manager

Former Committee Coordinator for West Coast Aircraft War Production Council to Direct All Institute Activities in Western Region.

James L. Straight.

On December 15, James L. Straight assumed the duties of Western Manager of the Institute of the Aeronautical Sciences with headquarters in Los Angeles, Calif. He was selected from a group of candidates on the recommendation of the engineering heads of the Pacific Coast aircraft companies.

The purpose of this new Institute office is to provide the maximum possible means for the interchange of current technical information, at this critical period in aviation development, among Institute members in all parts of the United States. As Western Manager, Mr. Straight's most important function will be to coordinate the facilities and services of the Institute with the requirements of members in the Pacific Coast Area.

In cooperation with national headquarters, Mr. Straight will supervise all Institute activities in the West Coast area, including the administration of meetings, membership, Section activities, and industry relations. As administrator of the Pacific Aeronautical Library of the Institute, Mr. Straight will be in charge of personnel, funds, property, and security regulations of the library. The library was established in 1936 and now serves as a focal point for the collection and distribution of essential and technical information for the West Coast aviation industry.

Mr. Straight is particularly qualified to direct the Institute's Western Regional affairs because of his close association with the Pacific Coast aeronautical industry in the past. During 1942–1945 he coordinated and supervised operations of some 30 committees for the Aircraft War Production Council. A large part of his committee work was of a technical nature, including engineering, testing and research, casting inspection, temperature effects, engineering man power, and inspection and statistical quality control. He supervised the writing and publishing of a complete manual of inspection standards, which was adopted in the aircraft industry as the first effort to define the ends sought by quality control. Other responsibilities included direction of the interchange of technical documents within the industry and creation of "pools" of technical data. Mr. Straight also conducted a project sponsored by the Office of Production Research and Development at the California Institute of Technology covering research in the art of removing metals.

In 1939, he was mayor of Boise, Idaho. Following his term in office and before his appointment as Committee Coordinator for the Aircraft War Production Council, he was affiliated with the American Aviation Associates and other aviation publications on the West Coast.

For the time being, until more suitable quarters can be secured, Mr. Straight's address will be 6715 Hollywood Blvd., Los Angeles 28, Calif. All members in the area should contact him on any I.A.S. business.

I.A.S. Calendar

January 28–30, 1947	Fifteenth Annual Meeting, New York, N.Y.
March 28,1947	Aircraft Propulsion Meeting, Cleveland, Ohio
May 26–27, 1947	Light Aircraft Meeting, Detroit, Mich.

For further details see page 19.

I.A.S. Honors Night Dinner and Annual Meeting Program

The Hon. W. Averell Harriman to Be Guest Speaker at Honors Night Dinner. Major Gen. Curtis E. LeMay, Rear Adm. L. C. Stevens, and the Hon. William A. M. Burden Will Speak at the Army, Navy, and C.A.A. Luncheons, Respectively

The Program for the I.A.S. Honors Night Dinner and the Fifteenth Annual Meeting has been tentatively completed. The guest speaker at the Honors Night Dinner on January 27 will be the Hon. W. Averell Harriman, former Ambassador to the U.S.S.R. and, at present, as Secretary of Commerce of the United States, responsible for the future of civil aviation in America.

The Institute has been fortunate in obtaining Major Gen. Curtis E. LeMay as guest speaker for the Army Day Luncheon, Rear Adm. L. C. Stevens on Navy Day, and the Hon. William A. M. Burden for the C.A.A. Day Luncheon.

Thirty-six papers will be presented during the three-day meeting in accordance with the following outlined program.

The Hon. W. Averell Harriman.

January 27, 1947

The Dinner will start promptly at 7:30 Monday night in the Grand Ballroom, Hotel Astor. The Hon. W. Averell Harriman, Secretary of Commerce, will speak on "Civil Aviation—A New Economic Frontier." The presentation of Honors and Awards will be included in the Dinner program.

January 28, 1947

On Tuesday, January 28, the morning session on "Structures" will be opened at 9:00 a.m. by Chairman Nicholas J. Hoff, Professor of Aeronautical Engineering, Polytechnic Institute of Brooklyn. The papers and speakers are as follows: "Critical Speeds of Shafts Under Torque," by Reinhardt M. Rosenberg, Instructor at the School of Aeronautics, Purdue University; "The Dynamics of a Swept Wing," by Herbert R. Lawrence, Staff Assistant, Chief of Aerodynamics, and Adam T. Zahorski and William E. Cox, Staff Assistants, Chief of Structures, Northrop Aircraft, Inc.; "Computation of Influence Coefficients for Aircraft Structures with Discontinuities and Sweepback," by Samuel Levy, Physicist, National Bureau of Standards; "Numerical Methods for the Calculation of Elastic Instability," by Bruno A. Boley, Instructor in the Department of Aeronautical Engineering and Applied Mechanics, Polytechnic Institute of Brooklyn; "Column Characteristics of Sandwich Panels Having Honeycomb Cores and Metal Faces," by W. W. Troxell and H. C. Engel, The Glenn L. Martin Company; and "Inelastic Column Theory," by F. R. Shanley, Division Engineer, Engineering Research, Lockheed Aircraft Corporation.

Major General Curtis E. LeMay, Deputy Chief of Air Staff for Research and Development, U.S. Army Air Forces, will speak on "The Air Forces' Development Program" at the Army Day Luncheon in the East Ballroom beginning at 12:30 p.m.

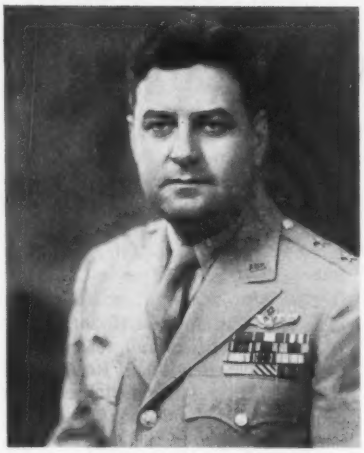
"Aircraft Design" will be the general subject of the papers presented in the afternoon session beginning at 2:30 p.m. Paul S. Baker, Engineering Manager, Chance Vought Aircraft Division, United Aircraft Corporation, will act as Chairman. The papers and speakers are as follows: "Design and Development of the P-80," by C. L. Johnson, Chief Research Engineer, Lockheed Aircraft Corporation; "High-Speed Research with the XS-1 Airplane" will be given in two parts: Part I—"Research Objectives and Instrumentation," by Walter C. Williams, Assistant Aeronautical Engineer, Flight Research Section, and Robert W. Byrne, Aeronautical Engineer, Langley Laboratory, National Advisory Committee for Aeronautics, Part II—"Design of the XS-1 Transonic Research Airplane," by Robert M. Stanley, Chief Airplane Engineer, and R. J. Sandstrom, Chief Preliminary Design Engineer, Bell Aircraft Corporation.

The 8:00 p.m. session, "Rotating Wing Aircraft," will be a joint session in cooperation with the American Helicopter Society. Alexander Klemin, Aeronautical Consultant, will act as Chairman. The following papers will be presented: "Notes on Helicopter Development," by Igor I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation; "Vibration and Oscillation Characteristics of the Helicopter," by Robert Coleman, N.A.C.A.; "C.A.A. Testing of Helicopters," by Ralph Lightfoot, Chief of Flight Research, Sikorsky Aircraft Division, United Aircraft Corporation; and "Helicopter Power-Plant Installations," by R. A. Wolf, Chief Engineer, Helicopter Division, and C. P. Spiesz, Bell Aircraft Corporation.

January 29, 1947

On Wednesday, January 29, the morning session will be devoted to the subject of "Flight Test." Chairman E. G. Stout, Chief of Naval Aircraft Research, Consolidated Vultee Aircraft Corporation, will open the meeting at 9:00 a.m. Three papers will be presented: "Progress of Dynamic Stability and Control Research," by William F. Milliken, Jr., Flight Research Department, Cornell Aeronautical Laboratory; "Raydist—A Precision Radio Navigation and Tracking System," by Charles E. Hastings, Chief Engineer, Hastings Instrument Company; and "Flight Testing of Guided Missiles," by Harold K. Cheney, Chief Flight Test Engineer, the Vultee Field Division, Consolidated Vultee Aircraft Corporation.

The Navy Day Luncheon will be given in the East Ballroom at 12:30 p.m. Rear Adm. L. C. Stevens, Assistant Chief for Research Development and Engineering, Bureau of Aeronautics, Navy Department, will speak on "Problems of Naval Aviation Which Confront the Aeronautical Engineer."



U.S. A.A.F. Photo

Major Gen. Curtis E. LeMay.

At 2:30 p.m. Chairman William R. Sears, Director of the Graduate School of Aeronautical Engineering, Cornell University, will open the first of two sessions on "Aerodynamics." Three papers will be given: "The Use of Damping Screens for the Reduction of Wind-Tunnel Turbulence," by Hugh L. Dryden, Associate Director, and G. B. Schubauer, Chief of the Aerodynamics Section, National Bureau of Standards; "A Method for Calculating Airfoil Sections from Specifications on the Pressure Distributions," by Glenn H. Peebles, Douglas Aircraft Company, Inc.; and "The Subsonic and Supersonic Flow About Slender Bodies," by E. V. Laitone, Section Head of Flight Research Engineering, Cornell Aeronautical Laboratory.

Immediately following this session the Annual Business Meeting of the Institute will be held at 5:30 p.m. The progress of the Institute during 1946 will be reported and new members of the Council and Nominating Committee elected. Nonmembers who have registered may attend the Annual Business Meeting.

"Aerodynamics II," will be opened at 8:00 p.m. by the Chairman, R. G. Robinson, Assistant Director of Aeronautical Research, N.A.C.A. The four papers will be: "Laminar Boundary-Layer Oscillations and Stability of Laminar Flow," by G. B. Schubauer, Chief of the Aerodynamics Section, and H. K. Skramstad, Chief of the Guided Missiles Section, National Bureau of Standards; "Linearized Treatment of Supersonic Flow Through and Around Ducted Bodies," by H. F. Ludloff, Assistant Professor of Aeronautical Engineering, New York University; "Oscillating Air Forces and Flutter at Supersonic Speeds (Two-Dimensional Case)" by I. E. Garrick, Physical Research Division, Langley Laboratory, N.A.C.A.; and "Aerodynamic Performance of Delta Wings," by H. J. Stewart, Associate Professor of Aeronautics, and A. E. Puckett, Chief of the Wind Tunnel Section of the Jet Propulsion Laboratory, California Institute of Technology.

January 30, 1947

On Thursday morning, January 30, two sessions will be held simultaneously: "Meteorology" conducted jointly with the American Meteorological Society in the East Ballroom by Chairman Henry G. Houghton, President of the American Meteorological Society; and "Aircraft Propulsion," in the North Ballroom by Chairman Edward S. Taylor, Professor of Aircraft Engines, Massachusetts Institute of Technology.

The four papers on meteorology will be: "Pressure Measurements from V-2 Rockets," by Nolan R. Best, Naval Research Laboratory; "Future Uses of High-Speed Computing in Meteorology," by John von Newmann, Institute for Advanced Study, Princeton University; "Discussion of the Possibility of Weather Control," by V. K. Zworykin, RCA Laboratory Division of the Radio Corporation of America; and "A New Operational Basis for Weather Forecasting," by B. G. Holzman, Research and Development, Headquarters, Army Air Forces.

At the same time three papers will be presented in the North Ballroom on "Aircraft Propulsion": "A Survey of the Calculated Performance of Jet Power Plants," by Joseph H. Keenan and Joseph Kaye, Department of Mechanical Engineering, Massachusetts Institute of Technology; "Performance Charts for Jet Propulsion Systems Consisting of Compressor, a Combustion Chamber, and a Turbine," by Benjamin Pinkel and Irving M. Karp, Fuels and Thermodynamics Division, Cleveland

The Hon. W. A. M. Burden.

Official U.S. Navy Photograph

Rear Adm. L. C. Stevens.

Laboratory, N.A.C.A.; and "Selection and Design of Rocket Power Plants," by W. C. Roberts, Power Plant Engineer, Bell Aircraft Corporation.

The Hon. William A. M. Burden, Assistant Secretary of Commerce, will speak on "The Engineers' Part in Civil Aviation Expansion," at the C.A.A. Day Luncheon in the East Ballroom at 12:30 p.m.

Chairman J. G. Borger, Chief Project Engineer, Pan American Airways, Inc., will preside over the 2:30 p.m. session on "Air Transport." Four papers will be delivered: "The Flying Boat and Its Commercial Uses," by Peter G. Masefield, Head of the Long Range Planning Division, Ministry of Civil Aviation; "Radio Aids to Navigation," by D. M. Stuart, Director, Technical Development Service, C.A.A.; "High-Speed Underwing Fueling," by Eric Olsen, Manager of the Aviation Division, The Wayne Pump Company; "Transport Problems with Turbine Power Plants," by Frank W. Kolk, Supervisor of Aircraft Planning, American Airlines, Inc.

The Symposium at 8:00 p.m., held jointly with the National Fire Protection Association, will be on the subject of "Aircraft Fire Protection and Prevention." E. E. Aldrin, Aviation Manager, Atlas Supply Company, and Chairman of the Executive Section, National Fire Protection Association, will be Chairman of the Symposium. The three papers will be: "Fire Protection Problems of Private Flying," by Jerome Lederer, Assistant Manager and Chief Engineer, Aero Insurance Underwriters; "Aircraft Design Fire Problems," by H. L. Hansberry, Acting Chief, Power Plant Development Section, C.A.A.; and "Some Aspects of Aircraft Fire Fighting," by George H. Tryon, III, Secretary, National Fire Protection Association.

Dr. Th. von Kármán Gives Tenth Annual Wright Brothers Lecture

Over 1,000 Hear Noted Scientist's Paper on "Supersonic Aerodynamics" in United States Chamber of Commerce Building, Washington, D.C., December 17.

On December 17, Dr. Th. von Kármán, renowned throughout the world for his outstanding contributions to the aeronautical sciences, presented the Tenth Annual Wright Brothers Lecture. His paper, "Supersonic Aerodynamics—Principles and Applications," was heard by an audience of over 1,000 in the auditorium of the Chamber of Commerce of the United States in Washington, D.C.

S. Paul Johnston, I.A.S. Director, opened the meeting by welcoming Dr. von Kármán on behalf of the Institute. Mr. Johnston read a cablegram from J. Laurence Pritchard, Secretary of The Royal Aeronautical Society and an Honorary Member of the Institute:

"The President, council, and all members of The Royal Aeronautical Society send to the Institute of the Aeronautical Sciences on the occasion of the reading of the Wright Brothers Lecture by your most distinguished lecturer Professor von Kármán their heartiest greetings. We are all looking forward to a closer cooperation between the Institute and ourselves in the near future and to have the opportunity of welcoming your members as friends of long standing to this country."

J. Laurence Pritchard

Mr. Johnston then introduced the Chairman of the Lecture, Dr. Hugh L. Dryden, Associate Director of the National Bureau of Standards. Announcing that the lecturer had arrived by air from Paris only a few minutes before, Dr. Dryden introduced Dr. von Kármán to the audience.

In discussing his subject of supersonic aerodynamics, Dr. von Kármán reviewed the fundamentals and reduced the basic ideas of the theory of wave drag and lift to three general rules: (1) the rule of forbidden signals; (2) zone of action and zone of signals; and (3) the rule of concentrated action. The elements of the theory of wave drag of slender bodies, as well as two- and three-dimensional supersonic wing theory, were sketched.

A short section dealt with ideas aimed toward total or partial escape from wave resistance by interference and sweepback. The transonic problem, the formation of shock waves, and their interaction with the boundary layer were discussed. Finally, an approximate method for range estimation of supersonic airplanes was presented.

Dr. Th. von Kármán.

"The basic rules of supersonic aerodynamics are entirely different from the basic rules of subsonic aerodynamics," Dr. von Kármán said. "A few years ago, the enormous drag at speeds approaching the velocity of sound led to the belief that crashing the 'iron barrier' of sonic speed was impossible." This has been disproved, Dr. von Kármán pointed out. New propulsion devices have been developed to produce sufficiently powerful thrust. New design concepts have evolved to reduce drag and avoid "shock waves." "We are at the stage," he said, "when this branch of aerodynamics should cease to be a collection of mathematical formulas and half-digested, isolated facts . . . . and be considered by the aeronautical engineer as a necessary prerequisite to his art."

Dr. von Kármán is widely known for his achievements in the fields of atomic theory, guided missiles, aerodynamics, elasticity, and hydrodynamics. At present, he is the Director of the Daniel Guggenheim School of Aeronautics at the California Institute of Technology. He has also been special scientific adviser to the Chief of the Army Air Forces for the past 3 years and now heads the new Army Air Forces Scientific Advisory Board. Under the direction of Gen. H. H. Arnold, he headed scientific missions into Germany to investigate German research in supersonics and guided missiles.

Dr. von Kármán is an Honorary Fellow of the Institute and received the Institute's Sylvanus Albert Reed Award for 1941. He is a member of, and has been honored by, most of the leading technical societies in the United States and abroad. He has been the Rouse Ball Lecturer of Cambridge University, England; presented the Wilbur Memorial Lecture of The Royal Aeronautical Society, England, in 1937; was the Gibbs Lecturer of the American Mathematics Society in 1939; and was the recipient of the American Society of Mechanical Engineers Medal in 1941. He was recently awarded membership in the Royal Society, England, an honor held at the present time by only 47 foreign scientists. During the Fall of 1946, he was awarded the Medal for Merit by the War Department in recognition of his work during the war.

At the conclusion of the lecture Dr. Dryden introduced the following civil and military leaders in the field of supersonic aerodynamics who had been selected to comment on various aspects of the lecture: Francis H. Clauser, Chairman of the Department of Aeronautics at The Johns Hopkins University; Capt. Walter S. Diehl, Bureau of Aeronautics Engineering Division, Navy Department; F. W. Geiger, Head of the Theoretical Aerodynamics Branch, Cornell Aeronautical Laboratory; Col. Paul H. Kemmer, Chief of Engineering Plans, Engineering Division, Wright Field; and John Stack, Chief of Supersonic Research, National Advisory Committee for Aeronautics. Because of the lack of time, however, their comments were brief. The complete lecture and the full discussions will be published in an early issue of the Journal of the Aeronautical Sciences.

Sponsored by the Institute and endowed by The Vernon Lynch Fund, this annual event commemorates the first airplane flight made by Wilbur and Orville Wright at Kitty Hawk, N.C., December 17, 1903. On alternate years, the lecturer is selected from among outstanding aeronautical scientists from Europe and from the United States. Last year, Dr. H. Roxbee Cox, noted British engineer, discussed jet-engine developments.

Admiral de Florez Honored by Naval Order

Rear Adm. Luis de Florez, U.S.N.R., a Fellow of the Institute, was elected Commander of the Aviation Commandery of the Naval Order of the United States, at the annual meeting of the Order held in the Harvard Club, New York City. The Naval Order of the United States is the oldest existing naval organization devoted to naval interests other than Naval Academy groups. Admiral de Florez has also been appointed by the Secretary of the Navy to the Naval Research Advisory Committee. Until recently he was Assistant Chief of Naval Research.

Rear Adm. Luis de Florez.

Donnell W. Dutton Appointed Scientific Research Adviser

Donnell W. Dutton, Associate Fellow of the Institute, has been appointed Scientific Research Adviser to the Research and Development Division of the War Department General Staff. He is the Director of the Daniel Guggenheim School of Aeronautics at the Georgia Institute of Technology. Mr. Dutton has made many contributions to helicopter development and to wind-tunnel research.

Captain Ide Honored

Capt. John Jay Ide, U.S.N.R., an Associate Fellow of the Institute, has returned to the United States from London where he has served on the staff of the Commander, U.S. Naval Forces in Europe, for over 3 years. For his work as Assistant Naval Attaché for Air at the American Embassy and Head of Technical Air Intelligence, Captain Ide has been awarded the Commendation Ribbon.

Capt. J. J. Ide, U.S.N.R.

Dr. Albert A. Arnhym Commissioned

Dr. Albert A. Arnhym, Associate Fellow of the Institute and consulting engineer and aeronautical writer of Dayton and San Diego, Calif., has been commissioned a Colonel, Army of the U.S., and appointed deputy chief for technical operations, Air Documents Division, Technical Intelligence, Air Matériel Command. He serves under Colonel R. H. Curtis, division chief.

Previously on loan to the War Department from Solar Aircraft Company of San Diego, Colonel Arnhym served with the Army Air Forces Intelligence in the European Theater. Under Col. H. M. McCoy, he assisted at the Air Documents Research Center in London in the evaluation and processing of "liberated" documents and in studying technique of the German aircraft industry.

After transfer of the documents and functions to Wright Field, Colonel Arnhym became Editor-in-Chief of Air Documents Division. As this division was formed to expedite the documents program, he helped to put the work on a mass-production basis in order to speed valuable findings to industrial, Government, and research activities.

Col. Albert A. Arnhym.

General Spaatz Plans Direct Contact with All Former A.A.F. Personnel

All former personnel of the A.A.F. are requested to send their present addresses to Gen. Carl A. Spaatz, Commanding General, A.A.F., so that they can be kept informed of latest developments, plans of the Air Reserve Program, and other related subjects. Post cards for that purpose are available at post offices, theaters, schools, colleges, places of employment, and through the Civil Air Patrol, Boy Scouts of America, and other organizations.

Gifts to the Institute Collections

A large model of the airship "Akron" was received from the Goodyear Aircraft Corporation through the courtesy of Dr. Karl Arnstein. Two $1/_{30}$-scale models of the P-39D and the XP-59A fighter airplanes were sent by Bell Aircraft Corporation through the courtesy of Dexter Rosen and Walter T. Bonney, the XP-59A being the first jet-propelled fighter model to be added to the collection.

C. D. Hanscom sent 71 slides of World War I airplanes and 35 slides of details and operation of the Massachusetts Institute of Technology wind tunnel of about 1919–1920, with descriptions of the slides, adding to his previous generous gifts. Col. Harris Hull gave more than 35 items, including a photostatic copy of the Army Signal Corps contract of April 2, 1908, with the Wright Brothers for one airplane; a typewritten report of 1932 on air-mail operations by John B. Crane; and technical papers by Dr. Edward Warner and others. John H. Andrews, of Paradise, Pa., gave articles on aeronautical history in Lancaster County, a photograph of a balloon ascent by John Wise from Lancaster about 1847, and other historical items. Oscar Freymann gave clippings on his bicycle-driven flapping wing aircraft of 1896 and a copy of his own description of the machine. F. N. Frenkiel, of Toulouse, France, sent copies of several of his technical papers. Five books were given by the New York Society Library.

A Bibliography on Combustion, 1927—Jan. 1, 1945, was received from the Cornell Aeronautical Laboratory through the courtesy of Miss Elma T. Evans. A bibliography on German methods of testing materials was received from the British Ministry of Supply. Issues of the *American Aviation Daily* for 1945 were received from the Eclipse-Pioneer Division of Bendix Aviation Corporation through the courtesy of Miss Mildred M. Baker. Reports on icing and precipitation static were received from the Research Laboratory of General Electric Company through the courtesy of Vincent J. Schaefer. Photographs and manuals on Australian aircraft were sent by L. S. W. Smyth of Victoria.

Six breast wing insignia of the Royal Swedish Air Force were received from the Legation of Sweden through the courtesy of Capt. Joel Petterson. The Waterbury Companies gave 27 aeronautical uniform buttons through the courtesy of Mrs. Betty Gilpatrick. A song of the aeronautical adventures of "The Dog and The Cow" was sent by John H. Millar, of London. Five jigsaw puzzles of World War II airplanes and other items were received from Mrs. Bella C. Landauer, adding to her previous generous gifts. United Air Lines, Inc., gave its 100,000-Mile Club Pin. Island Air Ferries, Inc., gave its cap insigne.

A full set of *Flying Daily*, published during the National Aircraft Show at Cleveland, was received through the courtesy of John H. Lancaster. Other gifts were received from the American Road Builders Association; the British Liaison Section of the Air Documents Division at Wright Field, through John A. Sizer; J. M. Gwinn, Jr., of San Diego; and Dr. Frederic F. Hauptmann.

News of Corporate Members

Beech Aircraft Corporation, Wichita, Kan., has lent two airplane models to the University of Detroit's Aeronautical Engineering Department. One, valued at approximately $5,000, is a complete airplane model with movable control surfaces throughout. The construction is of laminated mahogany, and it is built to include strain gage equipment. The second model, valued at $1,500, is constructed with a 7-ft. wing span and has movable flaps and ailerons. The Wright Field Air Matériel Command has also provided the Engineering Department with two German jet engines for a period of one school year.

Boeing Aircraft Company has been requested by the Army Air Forces to resume operation of part of their former Boeing Superfortress School. Located on the northwest corner of Boeing Field in Seattle, the school will function as a training facility for Army personnel who will service the Army's new Boeing aircraft now under construction.

Firestone Aircraft Company is the new name for G & A Aircraft, Inc., at Willow Grove, Pa. G & A Aircraft, Inc., formerly the Pitcairn Autogiro Company, was acquired by the Firestone Tire and Rubber Company in 1943. At that time, it was producing CG-4A gliders and experimental autogiros.

After Firestone bought the company, it developed and produced the XR-9 and XR-9B helicopters for the Army Air Forces, as well as the commercial version of this helicopter, known as the GA-45. The plant at Willow Grove, in addition to helicopter construction and development, produces aircraft wheels and brakes and SuperFlex undercarriages.

General Electric Company has recently established an Aviation Division in their organization. Two subdivisions comprising this new Aviation Division are the Aircraft Accessories and Ordnance Division at Schenectady and the Aircraft Gas Turbine Division at the General Electric River Works, Lynn, Mass. The Aviation Division will be responsible for the sales and application engineering of aircraft equipment and instruments manufactured by General Electric. This includes jet engines, turbosuperchargers, electric motors, generators, ignition systems, automatic control devices, automatic pilots, and other aircraft electrical equipment.

Lockheed Aircraft Corporation holds the three top awards of the National Safety Council for aircraft industrial safety in plants exceeding 5,000,000 man-hours of work per month. An industry-wide rate of 8,106 man-hours lost per million was reported. Three of Lockheed's plants had ratings of 2.10, 3.19, and 3.76.

Minneapolis-Honeywell Regulator Company has opened new and enlarged headquarters in Los Angeles, at 2840 East Olympic Blvd. All divisions of the company, including its aeronautical branch, will be located there. In the past 18 months, the Los Angeles staff has been expanded from 17 to 24 employees.

Standard Oil Company of California, Aviation Division, plans to reinstate air-roof markings on its plants throughout the Pacific West. Standard Oil Company has more than 700 such plants, usually located on the edge of town and near a railroad. These air-roof markings will constitute a uniform and helpful navigation aid for fliers.

Sections and Branches

Boston Section

At the Boston Section meeting, October 17, at Harvard University, Program Chairman L. J. Fischer announced the following appointments: Nominating Committee Representative for Area Councilors, Prof. J. P. Den Hartog; and Chairman of the Nominating Committee, Prof. A. R. Rowgowski.

R. C. Molloy, Executive Research Engineer for United Aircraft's Research Division, described the design features of the Division's new wind tunnel at Hartford, Conn. He explained, with the aid of slides, the unusual features incorporated which account for the wind tunnel's adaptability to a wide variety of research projects. The tunnel is capable of testing complete power plants, aircraft components, propellers, and fundamental airfoils. Mr. Molloy stated that air speeds up to 600 m.p.h. can be simulated in this tunnel.

Two N.A.C.A. films, *The N.A.C.A. Free-Spinning Wind Tunnel* and *A Study of Airflow by Means of Smoke*, were shown. Thirty-four members were present.

On December 3, C. E. Pappas, Chief of Aerodynamics at Republic Aviation Corporation, Farmingdale, L.I., lectured on "The Physical Aspects of High Speed Aerodynamics." Mr. Pap-

pas described the changes in flow pattern that occur between the subsonic and transonic regions and the transonic and supersonic. This approach to high-speed airflow afforded a number of interesting comparisons which were of great interest to the Institute members in view of the originality of thought behind them. A color film of the Republic Rainbow and a short film presenting several high-speed runs of the Republic P-84 were shown.

The following new Advisory Board Members were announced: O. Koppen, Massachusetts Institute of Technology; W. McKay, Massachusetts Institute of Technology; R. S. Hall, General Electric Company; and C. F. Savage, General Electric Company.

Detroit Section

On November 6, Chairman T. N. Kelly introduced guest-speaker B. A. Benicke to 200 members and guests of the I.A.S. Detroit Section and the Engineering Society of Detroit, at a joint meeting held in the Rackham Building. In his paper, "Application of Radar to Air Traffic Control," Mr. Benicke, Acting Technical Assistant to the Director of C.A.A.'s Air Navigation Operations Service, discussed two methods of aircraft landing aids: the present C.A.A. procedure, and the Air Forces' application of radar.

Two films were followed by an informal discussion during which Mr. Benicke answered the audience's questions. One film analyzed the C.A.A. instrument-approach and landing procedure and the second examined radar as a detecting device with recommendations for its application to instrument-landing technique.

On December 4, the Detroit Section and the Student Branches from Wayne University, the University of Detroit, and the University of Michigan met at a joint dinner and technical meeting. Lt. John F. Zinski, A.A.F., gave a synopsis of two films: The first film shown contained captured pictures of German developments of missiles including the V-1 and the V-2 rocket bombs; the second film consisted of captured pictures of the Me 163.

Following the films, Lieutenant Zinski discussed the equipment in reference to specifications, performance, and fuels. Lieutenant Zinski compared the German equipment with our own developments, noting the inferior guiding methods found in German equipment. He discussed current developments in radio-controlled missiles in this country.

The meeting was closed following a discussion led by Chairman Kelly.

Hagerstown Section

On November 20, Section members met at the Washington County Museum in Hagerstown, Md. All officers and Advisory Board Members elected are associated with the Fairchild Aircraft Division of the Fairchild Engine and Airplane Corporation. Permanent officers for the first term are: Chairman, Joel M. Jacobson, Assistant Chief Engineer; Vice-Chairman, Roy W. Lessard, Chief of Structures; and Secretary-Treasurer, G. I. Hackenberger, Jr., Junior Group Engineer.

Advisory Board Members are: Armand J. Thieblot, Chief Engineer; William P. Maloney, Group Engineer; Melvin A. Cawl, Group Engineer; and Dan Weller, Chief Flight Test Engineer.

Dr. A. W. Davison, Research Chemist at Owens-Corning Fiberglas Company, presented a paper entitled "Fiberglas, A New Engineering Material." Dr. Davison discussed the production techniques and applications of the various forms of Fiberglas, with particular reference to aircraft. He described tooling and production methods from the standpoint of the aircraft manufacturer. Low-cost wooden tools and low-heat and low-pressure forming methods made possible with this material, were emphasized.

Samples of the material in its various forms, together with specimens of finished parts of many varieties were on display.

During the discussion that followed the talk, it became evident that a number of new applications for the material had been visualized.

Los Angeles Section

By G. R. Mellinger, *Secretary*

The annual business meeting was opened at 8:00 p.m., November 20, by Arthur E. Raymond, President of the Institute, who announced that C. L. Johnson had sent his regrets and was unable to attend the meeting because of business in the East. Mr. Raymond continued with some general remarks on the program of the Institute during the past year.

The annual report of the Secretary and that of the Treasurer were presented by G. R. Mellinger. L. E. Root, Program Chairman, reviewed the meetings of the past year and emphasized the broad topic coverage. J. E. Barfoot, Chairman of the Membership Committee, reported that the membership of the Los Angeles Section had increased from 700 to 1,000 members during the past year.

In the absence of Dr. Norton Moore, Chairman of the Nominating Committee, nominations for next year's officers were announced by the Secretary, G. R. Mellinger, as follows: Chairman, L. E. Root; Vice-Chairman, Ward Beman; Secretary, Albert C. Reed; and Treasurer, F. Wagner. The names of these candidates were approved by letter ballot of the Los Angeles membership previous to this meeting. The business meeting was closed by the announcement that the above-named men were thereby elected to serve as officers of the Los Angeles Section for the coming year.

L. E. Root, Chairman of Los Angeles Section.

The technical session was opened by the showing of a sound movie in color, entitled *Operations Crossroads.* The film depicted in detail the preparations and organizations for both "Able Day" and "Baker Day." The actual explosion of the two bombs was photographed from a number of different angles and presented an awe-inspiring spectacle.

Dr. A. L. Klein, who was present at both "Able Day" and "Baker Day" in the capacity of radiological observer, disclosed a number of exceedingly interesting personal observations of the experiment. His work consisted of inspecting personnel, equipment, and the explosion area for signs of radioactivity. His amusing and informative discussion was enthusiastically received by all the members, and a lively question-and-answer period followed.

New York Section

By G. W. Brady, *Chairman*

The third meeting of the New York Section of the I.A.S. for the year 1946–1947 was held at the Hotel McAlpin on November 13. An audience of over 350 members and guests attended to hear J. Carlton Ward, Jr., President of the Fairchild Engine and Airplane Corporation speak on "The Significance of Some

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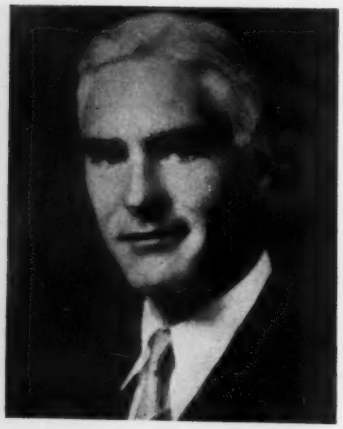

J. Carlton Ward, Jr.

of the Aspects of the Bikini Experiment." G. W. Brady, Section Chairman, presided and E. V. Lester, Program Chairman for the November meeting, introduced the speaker. Mr. Ward was one of the Army observers on the air-burst test at Bikini in July, and his company is active in one of the atomic power projects.

Mr. Ward started his discussion with a description of atomic energy and how it differs from chemical energy. He mentioned that in chemical energy release the atomic changes are only in a slight rearrangement of the electron structure, whereas in atomic or nuclear energy release there is a change in both the nuclear and electron arrangements. The different forms of uranium were mentioned, as well as the new element, plutonium, which is suitable for use in the atomic bomb. The process of fission with its terrific release of energy when the critical size is sufficiently exceeded and the mechanism of the chain reaction were also discussed. Because of the security restriction still imposed on this subject Mr. Ward was limited on the detail to which he could go in discussion of the release of atomic energy, but he did say that the energy produced by one of the atomic bombs was only that which would be obtained by complete transformation of a mass of a fraction of a postage stamp.

In describing the actual Bikini tests Mr. Ward outlined the elaborate organizations that were built up to perform the actual bombing, to record the data, and to make subsequent tests and examinations of the damage inflicted. He was emphatic in deploring the early reports that were issued minimizing the destructive effect of the bomb. He affirmed from personal observation that it was impossible to overstate the terrific destructive power of the bomb, both from the standpoint of physical damage to the target and also in the subsequent damage to living beings, whether men or animals, because of slow-acting radiation effects.

Projects to develop peacetime uses of nuclear reaction and radioactive material were also mentioned by Mr. Ward. Medical uses to treat malignant diseases and many others will be some of the most important products of the atomic development as radioactive materials of various concentrations become more readily available. Development of power plants to utilize the energy release of nuclear fission is another field where great gain can be obtained. Mr. Ward expressed himself as optimistic regarding the success of this development.

Following Mr. Ward's talk he presented the U.S. Navy film *Operations Crossroads*, showing both the air and underwater atom bomb tests at Bikini.

Philadelphia Section

By Seymour Gottlieb, *Secretary*

On November 6, the Philadelphia Section held a joint meeting with the Franklin Institute of Philadelphia. The meeting was held at the Franklin Institute and was preceded by a dinner attended by approximately 100 members and guests. Attendance at the meeting was approximately 300.

Carl de Ganahl, Vice-Chairman of the Section, presided at the meeting and introduced the guest speaker, Dr. George Gamow, who presented a talk on "Atomic Energy." Dr. Gamow is Professor of Theoretical Physics at George Washington University, is a member of the Army Air Forces Scientific Advisory Board, and played a primary part in the atom bomb development. He is the author of books that present the fields of science with lightness and humor for interesting reading by the layman.

Dr. Gamow's talk was a simplified discussion of atomic theory, the phenomena of fission and fusion, large-scale nuclear chain reactions, atomic explosions, and the use of atomic power for peaceful purposes. The talk was highly informative and was presented in a most entertaining manner. Of special interest was Dr. Gamow's present feeling of doubt as to the immediate use of atomic power for peaceful purposes because of the extremely high temperatures of atomic reactions which also produce large forces. An atomic bomb-powered rocket would be prohibitive in size and weight at present because of the wall thicknesses required to withstand the blast effects.

Dr. Gamow was skeptical of the use of atom bombs in warfare because a relatively small number, though effective against the enemy, might prove deadly to the user and a great mass of mankind when clouds of radioactive atmosphere are wind-blown along the earth's surface. A question-and-discussion period was conducted by Dr. Gamow following his talk.

Carl De Ganahl, Chairman of Philadelphia Section.

Operations Crossroads, a color movie with sound commentary of the two Bikini explosions, was shown. The film was made by the Public Relations Section of the Navy Department and proved to be the finest picture of the Bikini tests yet shown to the public.

On December 3, members of the Executive Committee held a meeting. The resignation of L. B. Kalinowski, Chairman of the Philadelphia Section, who has moved from the area, was formally accepted. Mr. Kalinowski's outstanding endeavors as Vice-Chairman and Chairman of the Section have been a principal factor in the establishment of a well-functioning Section and in the arousing of member interest in the Section.

Carl de Ganahl, Vice-Chairman of the Section, succeeded to the Chairmanship and requested nominations for the position of Vice-Chairman, to be elected by the Executive Committee at the next Committee Meeting.

Suggestions were received for the program for the Section meeting to take place in May, which will complete the season's activities. Papers on "Automatic Control of Aircraft," "Instrumentation of Aircraft," "Philadelphia as an Air Cargo Center," and "Design of a Lightplane" were considered. The holding of a forum meeting was felt advisable.

Mr. Cheeseman, Chairman of the Motion Picture Committee, presented a list of available films and selections were made for future meetings. Each Section meeting will be concluded by the showing of a technical film.

A larger and more suitable meeting place was discussed, and further investigation will be made of suggested

places. Contact has been established by John Rogers with the colleges in the vicinity, and students interested in the aeronautical sciences have been invited to the Section meetings. Provisions to accommodate a meeting attendance of 100 appears to be necessary.

San Diego Section

By William B. Barkley, *Corresponding Secretary*

On October 14, 1946, the first meeting of the newly elected officers of the Section was called by the Chairman, R. B. Johnston. At this meeting the subcommittee chairmen were appointed as follows: Jack Mason, Building Committee; E. G. Stout, Nominating Committee; Irving Nestingen, Membership Committee; Joel Whitney, Publicity Committee; Nadim Farrar, Meetings Committee; Charles Blake, Representative to Council of Technical and Scientific Societies in San Diego, and E. G. Stout, Alternate Representative to above Council. These men will serve as Chairman of their respective subcommittees for the fiscal year ending September 27, 1947.

On November 20, 1946, the Advisory Management Committee had their first meeting. At this meeting, the new Section Rules and Regulations were reviewed, and matters pertinent to the management of the Section were discussed.

The first meeting of the San Diego Section for the fiscal year 1946–1947 was held as a dinner meeting, Friday evening, November 22, on the Marine Roof of the Hotel San Diego.

The meeting was brought to order by Chairman Johnston, who welcomed approximately 130 Section members and guests.

Mr. Johnston introduced the speaker, Dr. A. L. Klein, a Fellow of the Institute, Design Consultant of Douglas Aircraft Company, Inc., and an Associate Professor of Aeronautics at California Institute of Technology. Dr. Klein spoke on "Operations Crossroads." He was able to give an excellent first-hand report of the action at Operations "Able" and "Baker," since he held a staff position as Technical Observer in the Radiological Safety Section. This Section of the Task Force was the first to be sent into the test area, following the detonation of the bombs, in order to determine which areas were safe for personnel and equipment. This being the situation, the speaker had the opportunity to observe the extent of the damage caused by the bomb soon after its force had been spent. He stated that one marked difference between Operations "Able" and "Baker" was that in Operation "Able" (bomb dropped from the air) it was the equipment above the water that was dangerously radioactive, while in Operation "Baker" it was the water that was radioactive, and their section had to patrol the water constantly to make certain that changing currents had not brought the radioactive water back into the area.

Supplementing Dr. Klein's talk, the Section Executive Committee showed two motion pictures of "Operations Crossroads"—one, a black and white film; the other, a technicolor motion picture of joint Army-Navy origin. Dr. Klein made comments during the films, pointing out some of the more interesting details.

A discussion period was then opened. A great flood of questions was asked of the speaker, all of which were ably answered.

On November 27, 1946, a special meeting of the Advisory Management Committee was held to accept the Constitution and By-Laws of the Council of Technical and Scientific Societies of San Diego and also to propose several nominations for officers of the Council.

At the September meeting a schedule of meeting dates was chosen and the Meeting Subchairmen for those meetings were named. The meeting dates are as follows:

November 22, 1946. . K. E. Ward
January 10, 1947. . . . Nadim Farrar
February 21, 1947. . . Joel Whitney
April 4, 1947. . . . . E. G. Stout
May 23, 1947. . . . . H. I. Mandolf (joint meeting with S.A.E.)
July 11, 1947. . . . . Irving Nestingen
September 27, 1947. . J. Mason

Seattle Section

The following officers were elected by members of the Seattle Section for the current year: Chairman, George S. Schairer; Vice-Chairman, Kenneth J. McLean; Secretary, Gene B. Williams; Treasurer, Russell H. Ashleman; and Section Representative to the Nominating Committee for Area Councilors, A. E. Merrill.

George Schairer, Chairman of Seattle Section.

Wichita Section

Forty-five members and guests of the Wichita Section were present at a combined business and technical meeting in the Drolls Dining Room on November 12. Elton H. Rowley, Chief of Boeing Aircraft Corporation's Engineering Flight Test Division at Wichita, presented a paper, "A Design for Power Soaring." He described the problems encountered in designing a removable power plant and a folding propeller installation for use in sailplanes. Mr. Rowley displayed several engine parts and drawings of the folding propeller.

At the business session the following members were elected to office: Chairman, Kennedy Razak; Vice-Chairman, Robert W. Allred; Secretary Preston Dickson; and Treasurer, Wilfred Pearce.

Academy of Aeronautics

At a meeting on October 8, Robert J. Erler, Director of Engineering Personnel at Chance Vought Aircraft Division of United Aircraft Corporation, described various personnel problems that he has encountered in his present position. At a meeting on October 22, two speakers presented papers: Albert N. DeVita discussed the construction, performance, and commercial value of the Republic Rainbow; and Margaret M. Liebhauser described a new-type swivel landing gear that has been tested in this country and in England.

A dance, sponsored by the Branch, was reported to be successful, and plans are in progress for a second social event in January.

Chairman Horace B. Edwardsen announced at the last regular meeting that all program arrangements had been completed for the fall term, highlights of which are a film from Bell Aircraft, *Report on Jet Propulsion;* a tour by the Senior Class of the maintenance facilities at one of the local air lines; and a lecture by a representative of the Republic Aviation Corporation describing the departmental coordination necessary in a new design.

At a technical meeting on November 19, Raymond Vachss presented a paper on "Departmental Coordination on a New Design." For an example he used the new Republic Rainbow.

The meeting on November 26 was partially devoted to business and to student lectures. Daniel McElwain talked on the high points of designing an airplane for comfort. Al Parzel

HANGAR FLYING

LOCKHEED

Hummingbirds vs. Constellations

Hummingbirds, who hold the record, can fly 600 miles without refueling. And it doesn't take a John J. Audubon to figure out that hummingbirds are probably pretty tired cookies when they land. But the *Constellation*, no slouch itself when it comes to records, can now fly more than 4000 miles nonstop without even breathing hard—thanks to its new long-range wing.

The wing adds about a thousand miles to the plane's range. An extra tank inside each of the two outer wing panels increases gasoline capacity by over a thousand gallons—with a weight

increase of only 600 pounds (exclusive of the gas, of course).

And, according to certain cabalistic signs which engineers love to make on graph paper, the payload of such *Constellations* is doubled in the latter stages of a flight. Money in the bank.

Adding another thousand miles to the long-range *Constellation* may sound like gilding the lily. If that's what it is, Lockheed spends an important part of its time lily-gilding—constantly making the *Constellation* a better plane. And making better hangar flying, too.

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©1947, Lockheed Aircraft Corp., Burbank, Calif.

lectured on radio-controlled test planes. He discussed their importance during the war as well as at the present time.

Carnegie Institute of Technology

Four meetings were held during the month of October. On October 10 in Machinery Hall, 50 members attended the first meeting of the semester and planned the activities for the year. New members were introduced by Chairman S. L. Collier. A business session on October 17 consisted of discussing the possibility of including flying training in the curriculum. At a technical meeting on October 24, H. W. Plohr gave a brief descriptive lecture on the Davis airfoil. At the last meeting of the month, October 31, a general discussion was led by the Chairman on aircraft repair and maintenance units.

University of Cincinnati

On November 14 the following officers were elected: Chairman, A. C. Nolte; Secretary-Treasurer, S. H. Reiter; and Head of Program Committee, M. I. Weinstein. The I.A.S. awards were explained to new members, and plans for the future were discussed. Meetings will be held at 11:30 a.m. every Thursday in the Student Union Building.

Fifty members attended a technical meeting on November 21. Plans for attending the Cleveland Air Show were discussed, and a General Electric film on jet propulsion was shown.

University of Detroit

Chairman James Glander presided at a meeting held in the University of Detroit's Engineering Building on October 21. The members were then shown a Bell Aircraft Corporation technical film, *Jet Propulsion*.

Members of the Branch are also active in the University's "Flying Club." The purpose of this organization is to combine practical flying experience with classroom theory. Members of the "Flying Club" plan to buy their own plane in the near future.

University of Michigan

Sixty members of the University of Michigan Branch heard Dr. M. H. Nichols lecture on "Rockets and Upper Atmosphere Research" at a joint business and technical meeting on November 14. German films of the V-2 rocket and the Me 163 were shown. Following the film, Chairman M. P. Murphy explained to the members the purpose and functions of The Paul Kollsman Lending Library.

At a technical meeting on November 26, Dr. T. D. Williams discussed "New Propulsion Devices," illustrated by N.A.C.A. slides that showed cross-section views of jet engines. The units described by Dr. Williams were: ramjet, pulse-jet, turbojet, combined reciprocating and turbojet, and a propeller powered by a turboengine.

Stewart Technical School

A new Student Branch, located at the Stewart Technical School, 253–257 W. 64th St., New York, elected officers and outlined the year's activities at their first meeting on November 12. The following officers were elected: Honorary Chairman, Mario DiGiovanni; Chairman, Robert W. Wagner; Vice-Chairman, Raymond Cannavaro; and Secretary-Treasurer, Leonard Petruk.

Tri-State College

The following officers were elected at a meeting of the Branch in the Aero-Science Building on October 7: Chairman, Wayne Austin; Vice-Chairman, Carlos Colon; and Junior Council Member, Anthony Italiano. The Senior Student Council Representative, Richard Trella, and the Secretary-Treasurer, Vern Shipley, retained their summer-election appointments.

Twenty-three members attended a meeting on October 21. Professor Hawthorne explained the purposes and plans of the Aeronautical Department and described the equipment available and its uses. The members voted to hold biweekly meetings.

University of Tulsa

New members were introduced by Chairman William Boyd at a meeting held on September 25 in the Phillips

All aboard for Hurricane-Homecoming Parade. "Follow me, men!" shouts jeep driver Bob Fred Mitchell as he hauls the TU Institute of the Aeronautical Sciences entry into place for the football parade before the Hurricane-Baylor Bears game. At his left is fellow engineer Kelly Barton, while Arnol Sellars, *left*, and Bob McDowell perch on the back seat. Grinning from the cockpit of the trimmed-down basic trainer, which the TU engineers use for classroom experiments, are Bill Boyd, *left*, and O. L. Deardorff.

Engineering Building. The business session consisted of making arrangements for a group picture for the school yearbook; setting a penalty for unexcused absences; and electing Robert Fred Mitchell Vice-Chairman of the Branch. It was agreed that meetings would begin at 8:00 p.m. on the second Wednesday of each month.

At a business meeting on October 9, plans were made to sponsor a float in the University Homecoming Parade. The possibility of using the Aeronautical Department's recently acquired BT-13 on the float was discussed. Branch dues were set at $1.00 per year.

"Your Future in Aviation" was the subject of a talk given by M. D. Saslaw, Spartan Aircraft Company Engineer, at a meeting on November 13 in the Phillips Engineering Building.

News of Members

The primary purpose of this column is to record the current activities of Institute members and provide information that is of interest and value to other members.

All members are invited (in fact, urged) to send in releases or letters promptly informing the editors of any changes in positions, promotions, achievements, or other news items.

Donald W. Angell is now a Structures Engineer at Aeronca Aircraft Corporation. He was formerly Vibration Engineer at Bell Aircraft Corporation.

Alison M. Arnold has completed his duties with the U.S. Navy and is now an Aerodynamicist at Bell Aircraft Corporation.

Irving Axelrod has resumed his position as Engineer at Curtiss-Wright Corporation.

C. Ogden Bailey is instructing in the Aeronautical Engineering Department at Oregon State College.

L. S. Barksdale, former Vice-President and General Manager of the Hydraulic Division of the Saval Company, has recently been advanced to the position of President of the company.

William P. Bireley, Lt. Col., U.S. Army Air Forces, is Chief of the Liaison Section of the Scientific Liaison Branch of the Research and Engineering Division. Before the war he was an Engineer at Douglas Aircraft Company, Inc.

Ralph F. Broberg is a Flight Test Engineer at Republic Aviation Corporation. He was formerly connected with the Engineering and Research Corporation as a Project Engineer and was Secretary-Treasurer of the Washington Section of the Institute.

Vincent E. Caswell is a Stress Analyst at Beech Aircraft Corporation. He has been connected with Universal Products Corporation.

Lewis Chow, prior to his present position as Stress Analyst in the Project Office of A. V. Roe Canada, Limited, was a Junior Research Engineer at the National Research Council in Canada.

Gene W. Clark, former Pan American Airways System Engineer, is now employed as an Engineer at Braniff International Airways.

Arnold Cowen, formerly engaged in Design and Layout work at Republic Aviation Corporation, is an Assistant Project Engineer at Reaction Motors, Inc.

Robert B. Dale, former Supervisor of Factory Liaison at Briggs Manufacturing Company, is now teaching at the Aero Mechanics Vocational High School in Detroit.

R. N. Dubois is a Professor of Motors in the Aeronautical Institute of Technology in Brazil. He was previously affiliated with the Packard Motor Car Company as Chief Experimental Engineer.

Robert S. Eikenberry has been promoted from Instructor to Associate Professor of Aeronautical Engineering at the University of Notre Dame.

Hallard L. Foester has taken a position as Service Engineer with the H. W. Foester Company.

Harold R. Foottit, Deputy Director of Aircraft Research and Development for the Royal Canadian Air Forces, was formerly Chief of Structures at The Ryan Aeronautical Company.

Gerard A. Gallagher has been elected President of Bar Harbor Airways, Inc. He was formerly Superintendent of Field Operations, Fleetwings Division, Kaiser Cargo, Inc.

L. S. Barksdale.

Buford E. Gatewood is now Associate Professor of Mechanics at the Army Air Forces Institute of Technology. He was previously affiliated with the Beech Aircraft Corporation.

Mellor A. Gill, former Curtiss-Wright Corporation Draftsman, is Research Assistant at the Manufacturers Aircraft Association.

Arthur W. Gilmore, former Junior Product Engineer at Sperry Gyroscope, Inc., is Teaching Assistant in the Department of Mechanical Engineering, University of California.

Daniel Grudin is Assistant Staff Engineer at Republic Aviation Corporation. Prior to Army service he was a Designer at the Curtiss-Wright Corporation.

Frank H. Hankins, Jr., has been named Division Operations Manager in charge of all operations throughout Pan American Airways Atlantic Division. Associated with Pan American Airways since 1933, he was Operations Manager of the Africa-Orient Division during the war, with the Air Transport Command.

Joseph T. Hartson, former Executive Vice-President of The Glenn L. Martin Company, is now President of the Goslin-Birmingham Manufacturing Company, Inc.

Thomas Heffernan is now Assistant to Works Manager at The Ryan Aeronautical Company.

Paul Chang-chih Huang, a Graduate Student at Rensselaer Polytechnic Institute, is now an Instructor at the school.

Bernard J. Ignasiak is in the Structures Department at Bell Aircraft Corporation. He has been a Stress Analyst at Consolidated Vultee Aircraft Corporation.

Charles M. Jamieson, former Chief Engineer at Culver Aircraft Corporation, is now the owner of Jamieson Aircraft Company.

Sidney Kaufman, after 3 years' active duty with the Engineering Division at Wright Field, is now Chief of Administration at the Army Air Forces Institute of Technology at Wright Field.

James P. Kearns, Jr., is an Instructor in Mathematics at Speed Scientific School and is also a Student in Law School at the University of Louisville. He held the position of Wind Tunnel Engineer in the Lone Star Laboratory Division, Consolidated Vultee Aircraft Corporation.

Alexander N. Kemp, member of the Board of Directors of American Airlines, Inc., has been presented the American Airlines Award of Merit for "unusually meritorious service in contributing materially to the growth of American Airlines." Mr. Kemp was selected in recognition of his wartime service as President of the air line from 1942 to 1945.

John E. Keppler is a Mechanical Engineer at the J. E. Ingram Equipment Company. He was formerly a Draftsman at The Glenn L. Martin Company.

Charles F. Kerbs, Jr., is now an Engineer at the Howard Foundry.

Henry H. Kerr, former Manager of the Western Branch of the Weatherhead Com-

William H. Klenke.

pany, is now a Development Engineer at United States Rubber Company.

Robert J. Kirkpatrick is New Products Engineer at the Westinghouse Electric Corporation.

William H. Klenke, Jr., has been appointed General Sales Manager of Consolidated Vultee Aircraft Corporation's Stinson Division at Wayne, Mich. Mr. Klenke joined the Aviation Corporation in 1939 to handle export sales for Stinson and was later appointed Assistant Sales Manager of Vultee Aircraft, Inc. Following a 4-year tour of duty with the Marines, the veteran pilot returned to Convair in May as Manager of the New York offices.

James A. Knowles is now a Draftsman at Douglas Aircraft Company, Inc.

Edwin H. Krug is an Engineering Instructor at Virginia Polytechnic Institute.

Nello A. Lamberti is now a Stress Analyst at McDonnell Aircraft Corporation.

Emory S. Land, President of the Air Transport Association, has been elected President of the Airline Union Terminal Corporation.

Oscar T. Larson, Assistant to the Vice-President of Operations, United Air Lines, Inc., has also been appointed Assistant in Administrative Matters.

Clifford J. Leisy is Chief Administrative Engineer in the Aircraft Research and Development Division at Willys-Overland Motors, Inc. He was formerly Chief Project Engineer at Lockheed Aircraft Corporation.

Otto H. Lunde, former Professor at the University of Alabama, is now an Aeronautical Engineer at the Bureau of Aeronautics in Washington, D.C.

Kazmier J. Mazanowski is now a Junior Design Engineer in the Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Wallace W. Meins, former Engineering Designer at Lockheed Aircraft Corporation, is now Lead Engineer at Boeing Aircraft Company.

Herbert F. Miller is an Airplane Instructor at the Pittsburgh Institute of Aeronautics. He was previously affiliated with Servair, Inc.

Frederick P. Mitchell is a Stress and Technical Analyst in the Technical Department of A. V. Roe Canada, Limited.

Nathan Ness has returned to Lockheed Aircraft Corporation as a Flight Test Analyst after serving in the U.S. Navy. Before the war he was Junior Engineering Assistant.

Cecil E. Parsons is a Detail Engineer in the Structural Development Unit at Boeing Aircraft Company.

William S. Patterson has returned to Douglas Aircraft Company, Inc., as a Stress Analyst after active duty in the U.S. Navy.

Roland W. Puder is a Research Fellow at the Polytechnic Institute of Brooklyn.

Walter Ramberg has been appointed Chief of the Engineering Mechanics Section of the National Bureau of Standards. Dr. Ramberg directed the Bureau's aeronautical research program since 1937. He is noted for his outstanding work in the field of aircraft structures and has contributed extensively to scientific literature on the strength of materials, the strength and instability of structural elements of aircraft, and the vibration of propellers.

B. G. Reed, Factory Manager of Northrop Aircraft, Inc., has been elected Vice-President in charge of manufacture.

Lewis E. Reisner has resigned his position as President of the Tennessee Aircraft, Inc., of Nashville, Tenn., a subsidiary of General Aircraft Corporation.

Donald E. Rialson is a Flight Test Engineer at Hughes Aircraft Company. Prior to Army service he was Stress Engineer at Lockheed Aircraft Corporation.

Raymond Ricci, Jr., is an Engineer at McDonnell Aircraft Corporation. He was formerly in the Airplane Division of Curtiss-Wright Corporation.

Richard N. Rioux is now an Engineering Instructor at the Aeronautical University.

Robert F. Robinson, a Graduate Student of Purdue, is now an Instructor at the University.

A. P. Fontaine, an Associate Fellow of the Institute, has recently accepted the position as Director of the University of Michigan's Aeronautical Research Center at Willow Run. For the past several years Mr. Fontaine has been connected with the Aircraft Development Department for Bendix Aviation Corporation.

Dr. Walter Ramberg.

Albert J. Rosenberg has been appointed Manager of the recently created Text-Film Department of McGraw-Hill Book Company, Inc.

Donald H. Sandler, former Salvage Engineer at Edo Aircraft Corporation, is now Production Engineer in the Pilotless Plane Division at Fairchild Engine and Airplane Corporation.

Robert L. Seebol, former Design Engineer at Warren MacArthur Corporation, is now Manager of Robert L. Seebol Associates.

Lawrence C. Sentker is now a Research Analyst at Hughes Aircraft Company.

Edward B. Shields, Jr., has returned to school as a Graduate Student in Aeronautical Engineering at Oregon State College.

Gerald F. Smith is a Student at the University of Oklahoma. Prior to serving in the Army Air Forces he was a Junior Stress Analyst at Northrop Aircraft, Inc.

Kenneth E. Smith has been appointed Director of the Department of Aeronautical Engineering at the University of Detroit.

Maurice D. Soloway, formerly an Engineer at United Aircraft Corporation, is now a member of the U.S. Army Air Forces.

David B. Stevenson is a member of C.A.A.'s Flight Engineering Division.

William I. Stieglitz, Design Engineer at Republic Aviation Corporation, has been issued a certificate designating him as the C.A.A.'s first authorized Company Structural Engineering Representative in Region One, as well as their agent at the Republic Plant.

Robert Allan Summers has joined the Massachusetts Institute of Technology as a Research Assistant.

Robert S. Tint has recently become a Senior Stress Analyst at Republic Aviation Corporation. Prior to this position he was Structures Group Leader in charge of rotor blades at Kellett Aircraft Corporation.

Robert E. Trick is a Junior Engineer at Boeing Aircraft Company.

Ralph B. Trublood, a Structures Engineer, has transferred to Fairchild Engine

and Airplane Corporation. He was formerly with the Aeronca Aircraft Corporation.

Henry F. Waring, Jr., is an Engineering Test Pilot at Cessna Aircraft Company. He was formerly an Aerodynamicist at North American Aviation, Inc.

Edwin A. Warren, former Vice-President of Operations for Slick Airways, Inc., is now Manager of Cargo Airplane Sales at The Glenn L. Martin Company.

Morris Yachter is Design Engineer in charge of Vibration and Flutter at Republic Aviation Corporation.

Campbell C. Yates is Assistant Professor at the University of Pittsburgh.

Raymond A. Young is Helicopter Design Engineer at the Bureau of Aeronautics, Navy Department. Formerly, he was Design Test Engineer at Kellett Aircraft Corporation.

Edwin A. Warren.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Donovan, Allen Francis, M.S. in Ae.E.; Head, Structures Dept., Cornell Aeronautical Lab.

Furnas, Clifford Cook, Ph.D.; Director, Cornell Aeronautical Lab.

Elected to MEMBER Grade

Arata, Winfield H., Jr., Production Design Engineer, Lockheed Aircraft Corp.

Baird, Abraham Lincoln, S.M.; Capt., Asst. Director, Power Plant Div., Bureau of Aeronautics, Navy Dept.

Billick, Paul George, Production Manager, Canadair, Limited (Canada).

Bingham, Kenneth Brooks, B.S. in M.E.; Wing and Nacelle Engineer, Douglas Aircraft Co., Inc.

Bowie, Clagett, LL.B.; Research Engineer, The Glenn L. Martin Co.

Boyd, John Robert, M.S.; Design Engineer, Douglas Aircraft Co., Inc.

Brevoort, Maurice J., M.A.; Research Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Close, Rodman Edward, B.S. in M.E.; Lt. Comdr., Project Officer, Bureau of Aeronautics, Navy Dept.

Connolly, Thomas Francis, M.S. in Ae.E.; Comdr., Asst. Director of Flight Test, U.S. Navy.

Conover, Albert Walton, Jr., Flight Research Manager and Chief Test Pilot, The Ryan Aeronautical Co.

Cornell, William George, M.E.; Research Engineer, General Electric Co.

Driscoll, John Joffre, Major, Instructor, Air Research & Development Div., Air War College.

Dunlavy, Harrison, B.S. in M.E.; Head of Engine Performance Section, Fredric Flader, Inc.

Eskin, Samuel G., M.S. in Physics; Director of Research, Robertshaw-Grayson.

Flynn, Neil Peirson, B.Sc. in Eng.; Asst. to Technical Director, Intava, Inc.

Goldstein, Arthur Wenick, M.S.; Physicist, Aircraft Engine Research Lab., N.A.C.A.

Hazen, John Wesley, M.S. in M.E.; Research Engineer and Lecturer, University of California.

Hosking, James Richard, B.S.E.; Flight Instrument Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Keasling, Chester Irwin, Aircraft Maintenance Design Engineer, Lockheed Aircraft Corp.

Kintas, John, B.S. in Ae.E.; Vibration Engineer, Beech Aircraft Corp.

Kirstein, Myron, B.M.E.; Physicist, David W. Taylor Model Basin.

Lary, Frank Byrd, B.S. in M.E.; Sr. Field Engineer, Wright Aeronautical Ltd.

Loevinger, David Neher, B.Ae.E.; Engineering Draftsman "A," El Segundo Div., Douglas Aircraft Co., Inc.

Malby, Howard Seargeant, A.B.; Research Engineer, Douglas Aircraft Co., Inc.

Maletz, Michael, M.E.; Analytical Mechanical Engineer, Kearney & Trecker Corp.

Miller, Walter Bernard, M.S. in Ae.E.; Lt. Comdr., U.S. Navy.

Owens, James Hamilton, Jr., Sr. Stress Analyst, The Glenn L. Martin Co.

Perfield, William James, B.Ae.E.

Reynolds, John Louis, Asst. to Engineering Vice-President, Jack & Heintz Precision Industries, Inc.

Rife, Charles Jacob, M.S.; Electronics Development Engineer, Bell Aircraft Corp.

Roberts, William Elbert, Jr., B.S. in C.E.; Stress Analyst, Lockheed Aircraft Corp.

Ross, Ira Guild, M.S.; Manager Flight Research, Cornell Aeronautical Lab.

Selvidge, Harner, D.Sc.; Director, Special Products Development, Bendix Aviation Corp.

Shoenhair, Jack Lawrence, Comdr., Head, Power Section, Planning Div., Office of Naval Research, Navy Dept.

Spindell, Philip Elliott, B.S. in Ae.E.; Project Engineer, Kellett Aircraft Corp.

Stephenson, Jack Dougal, M.S. in Ae.E.; Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

Targoff, Walter Peroy, B.M.E.; Sr. Vibration Engineer, The Glenn L. Martin Co.

Taylor, Elwood Browning, Chief Power Plant Engineer, Douglas Aircraft Co., Inc.

Torda, Paul, Dipl. Ing.; A.F.R.Ae.S.; Research Associate, Polytechnic Institute of Brooklyn.

Towle, Josiah Claramont, Chief Pilot, Lockheed Aircraft Corp.

Wagner, George Peter, M.E.; Owner, George P. Wagner Associates.

Transferred to MEMBER Grade

Hayes, Henry Leon, Stress Analyst, Beech Aircraft Corp.

Hill, Thomas Gardner, B.Ae.E.; Sr. Layout Designer, Power Plant Section, The Glenn L. Martin Co.

Holmes, William Charles, Jr., M.A.; Aerodynamicist, Northrop Aircraft, Inc.

Sager, Robert Charles, B.S. in Ae.E.; Flight Test Engineer, Cornell Aeronautical Lab.

Shaver, John Willard, B.S. in Ae.E.; Production Design Engineer Class "A," Douglas Aircraft Co., Inc.

Weiss, Herbert Klemm, M.S. in Ae.E.; Ballistician, Chief, Weapons Effectiveness Section, Aberdeen Proving Ground, War Dept.

Elected to Associate Member Grade

Beers, John Cornwell, Asst. Manager, Aviation Dept., Atlas Supply Co.

Bunkley, Joel William, B.S.; Rear Admiral, U.S.N. (Retired), Chairman of the Board, American Helicopter Magazine Inc.

Fink, George Edward, Service Representative & Technician, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Powell, Geoffrey Lawrence, Asst. to Manager, Atlas Supply Co.

Prickett, Robert Henry, B.S.; Comdr., Head, Program Planning Branch, Bureau of Aeronautics, Navy Dept.

Watson, Thomas John, Jr., Ph.B.; Vice-President, International Business Machines Corp.

Elected to Technical Member Grade

Anders, David, Flight Engineer, U.S. Army Air Forces.

Andrews, Clarence Henry, Jr., Ae.E.; Jr. Engineer, Fairchild Aircraft Corp.

C.A.A. No. R-1

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Arndt, Robert Elmer, M.Sc.; Pvt., U.S. Army Air Forces.

Baier, Robert Jerome, Ae.E.; Group Engineer, Bellanca Aircraft Corp.

Barry, William Richard, B.A.; Sr. Engineer, The Glenn L. Martin Co.

Caouette, J. Henri, Design Expeditor, Canadair, Limited (Canada).

Cooley, William Crockett, B.S. in M.E.; Research Analyst, North American Aviation, Inc.

Hagan, Ronald George, Technical Illustrator, Canadair, Limited (Canada).

Hess, Fred David, Jr., B.S.; Liaison Engineer, Consolidated Vultee Aircraft Corp.

Johnson, James Duncan, Jr., 1st. Lt., U.S. Marine Corps.

Johnson, Ralph Winthrop, B.S. in M.E.; Stress Analyst, Sikorsky Aircraft Div., United Aircraft Corp.

McCoy, Allan William, B.S.; Aeronautical Research Engineer, Research Div., United Aircraft Corp.

Mitchell, John Crumley, B.S.; Lt., Asst. Assembly and Repair Officer, U.S. Navy.

Moore, David Henry, Jr., Design Engineer, Consolidated Vultee Aircraft Corp.

Oates, Charles Edward, Designer "B," Northrop Aircraft, Inc.

Salerno, Joseph Michael, B.S. in Ae.E.; Flight Engineer, Pan American World Airways.

Steele, Theodore Karl, B.M.E.; Experimental Test Engineer, Stratos Corp.

Warren, Ida Leane, Miss, M.A.; Aerodynamicist, Piasecki Helicopter Corp.

Wilson, Melvin Noble, Jr., M.S.; Aerodynamicist, The Ryan Aeronautical Co.

Transferred from Student to Technical Member

Bertram, Michel Henry, B.Ae.E.; Aeronautical Engineer in Mechanical Branch of Engineering Div., U.S. Army Air Forces.

Blose, Donald Howard, B.Ae.E.; Aeronautical Engineer P-1, Air Matériel Command, Wright Field.

Bramon, A. Stanley, B.S. in Ae.E.; Stress Analyst, Goodyear Aircraft Corp.

Clark, Samuel Kelly, B.S. in Ae.E.; Mathematician—Stress Group, Douglas Aircraft Co., Inc.

De Nigris, Donato David, B.Ae.E.; Computer, Republic Aviation Corp.

de Souza, José Franco, B.Sc.; Engineer, Ministry of Aeronautics (Brazil).

Doty, Paul Robert, B.Ae.E.; Project Engineer, U.S. Army Air Forces.

Foringer, Donald Eugene, B.S. in Ae.E.; Engineer (Research), California Research Corp.

Garland, Newton Cluff, B.Ae.E.; Research Engineer, United Aircraft Corp.

Grobe, Roy B., B.S.; Detail Engineer, Boeing Aircraft Co.

Hendel, James Norman, S.B.; Test Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Kenny, Thomas Martin, B.S. in Ae.E.; Jr. Stress Analyst, The Glenn L. Martin Co.

Knapp, Ronald J., B.S. in Ae.E.

Korn, Joseph, B.Ae.E.; P-1 Aeronautical Engineer, Air Matériel Command, Wright Field.

Lewis, James Woodward, B.S. in Ae.E.

Lochte, Elgin Harry, B.S.; Graduate Student, Agricultural & Mechanical College of Texas.

Meyer, John Richard, B.Ae.E.; Graduate Student.

Miller, Robert August, B.Ae.E.; Draftsman, The Glenn L. Martin Co.

Mojcher, Frank George, B.S. in Ae.E.; Experimental Liaison Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Mueller, James Newton, B.S.; Aeronautical Engineer P-1, Langley Mem. Aero. Lab., N.A.C.A.

Nitikman, Herschel, M.Sc. in Ae.E.; Aerodynamicist "B," Northrop Aircraft, Inc.

Rotman, Morton J., B.Ae.E.; Ensign, U.S.N.R.

Shackelford, Ernest Dabney, Jr., B.Ae.E.; Co-Owner, Engineering Designers & Draftsmen.

Shannon, John Leo, Jr., B.Ae.E.; Graduate Student, Rensselaer Polytechnic Institute.

Sheak, Richard Robert, B.Sc. in Ae.E.; Detail and Layout Engineer, Boeing Aircraft Co.

Taranto, Francis Felix, B.Ae.E.; Jr. Engineer, Boeing Aircraft Co.

Tellerman, Lowell, B.Ae.E.; Draftsman, Republic Aviation Corp.

Thielker, Armand Lahrmann, B.S. in Ae.E.; Test Engineer, Allison Div., General Motors Corp.

Tiefel, Paul Martin, B.S.E.; Ensign, U.S.N.R.

Walker, Thomas Judd, B.S.; Instructor, Carnegie Institute of Technology.

Weitzenkorn, William Williams, B.S.; Detail Engineer, Boeing Aircraft Co.

Wollner, Bertram Clarence, B.Ae.E.; Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

I.A.S. National Meeting Schedule

Aircraft Propulsion Meeting—Cleveland, Ohio, Carter Hotel—March 28, 1947

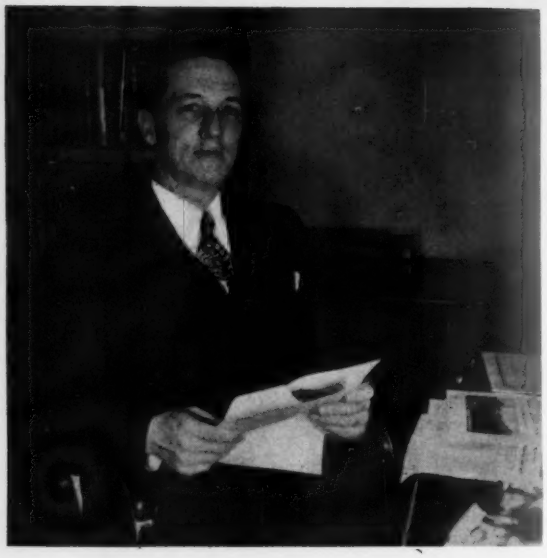
Light Aircraft Meeting—Detroit, Mich., Horace H. Rackham Educational Memorial—May 26–27, 1947

The Meetings Committee of the Institute invites participation in the technical sessions of the Light Aircraft Meeting.

Members or organizations wishing to submit papers for this meeting should send complete papers, or outlines or summaries, to the Meetings Committee at least three months prior to the meeting. Outlines or summaries should not exceed 1,000 words.

All papers submitted will be considered for publication in the *Journal of the Aeronautical Sciences* or the *Aeronautical Engineering Review.*

All correspondence should be addressed to The Meetings Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.



WHO'S WHO ON THE REVIEW

DIRECTOR OF PUBLICATIONS

Welman A. Shrader, who joined the Institute Staff in 1943 to produce and edit the first *Aeronautical Engineering Catalog*, has recently been appointed Director of Publications. In this capacity, he serves as Editor of both the *Review* and the *Catalog* and is responsible for production of the *Journal of the Aeronautical Sciences*, preprints of technical papers, and other Institute-published literature.

Mr. Shrader's activities in the field of aeronautics began in 1929 when he obtained his pilot's license and served as aerial photographer for the Photographic Division of Curtiss-Wright Corporation. In 1933, he organized the Aero-Graphic Corporation, at Louisville, Ky., which company he headed until the outbreak of war. During that period, this corporation specialized in the making of aerial photographs and the publication of pictorial travelogue books. His experiences in the publication and aeronautical fields were further broadened during 1941–1942 when he served as President of Text Research & Education.

In the selection of technical articles and material for the *Review*, Mr. Shrader has the assistance and guidance of a Technical Advisory Committee.

TECHNICAL ADVISORY COMMITTEE

This committee determines the editorial content of the *Review* and *Journal* and supervises the selection of technical articles for both magazines. In this latter task they have the assistance of the Editorial Committee. The Editorial Committee, composed of experts in the various branches of the sciences, reviews all papers submitted and makes recommendations for their publication.

Hugh L. Dryden

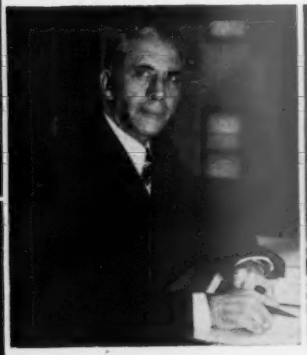
Robert R. Dexter

S. Paul Johnston

THE EDITORIAL STAFF

Berneice H. Jarck
Associate Editor

Lillian E. Bermont
Assistant Editor



Harris F. Reeve
Reviews, Managing Editor

Edward G. Ingram
Reviews, Technical Editor

John F. Mason
News Editor

John J. Glennon
Library Liaison

Editorial

What About the *Review*?

By this time, many I.A.S. members have become aware that the REVIEW has had its face lifted in the past few months. Beginning with the July, 1946, issue, certain changes in format were made—new cover layout, new contents page, a rearrangement of "departments," and the inauguration of an Editorial page. Every succeeding issue has been carefully studied, and minor improvements have been made in typography and page layouts when they seemed appropriate.

With this issue, Volume 6, No. 1, further changes are in evidence. Most obvious is the reduction in overall size, a change agreed upon by all publishers at this time in the interest of saving paper. In this respect, we are back on a wartime footing. More important, however, is the change that has been made in the "Aeronautical Reviews" section. No expediency, this—but a carefully planned step toward improving the service which the REVIEW renders to its readers.

When the REVIEW was started, its primary purpose was to provide Institute members with an up-to-date abstract and indexing service on current literature covering the aeronautical sciences. Busy engineers have little time and but limited opportunity to scan the vast flood of books, magazines, reports, and other publications on aeronautical subjects that pour from the world's printing presses, yet every month, somewhere in the stream, are items invaluable to them in their daily work. The Institute properly took on the job of screening the literature for them; classifying, indexing, and abstracting the important publications from here and from abroad; and, through the pages of the REVIEW, giving the results to its membership. Because of the possession of its libraries, it was in a particularly favorable position to do so.

During the 5 years of its existence, the REVIEW has not deviated from its original purpose. Some things have been added, but its primary mission is to keep its readers posted on current events in aeronautical literature. With the release of wartime restrictions on information, more and more significant articles are appearing in the technical press at home and abroad, and it is more important than ever that I.A.S. members everywhere be given a brief, accurate, and *current* evaluation of them as fast as they appear. With this in view, the Institute staff has been reorganized to bring the libraries and the REVIEW closer together and, in spite of paper limitation and a curtailed publication budget, to extend the quantity and quality of our coverage. Classification of articles is being intensively studied and improved. Abstracts are being briefed by elimination of extraneous matter. A new style of presentation has been adopted which is consistent with other technical abstracting services and which is geared into the indexing systems of technical libraries.

Your editors make no claims that perfection has been attained in this regard. Constant study of details will be made to improve this service as time goes on. Comment and constructive criticism will be more than welcomed.

The REVIEW, of course, fills other needs. Through its "I.A.S. News" pages, members are kept informed of its activities, local and national. Its articles supplement those of the JOURNAL in the more practical fields of aeronautical engineering. Its personnel services give help to its members who are searching for jobs or men. Finally, this Editorial page gives an opportunity for your Director to discuss some of the day-to-day problems of our organization. The entire staff has only one objective—to make the REVIEW interesting, but above all, *useful* to I.A.S. members. *S. P. J.*

Design and Development of the Douglas XB-42

CARLOS WOOD*

Douglas Aircraft Company, Inc.

Introduction

Following considerations of efficient types of offensive military weapons, the Douglas company proposed the construction of a new-type bomber airplane to the U. S. Army Air Forces in May, 1943. The foreseeable strategic situation required a minimum operating radius of at least 2,000 miles.

Normally, requirements for increased range or increased bomb load always result in large aircraft, a doubling of either range or bomb load resulting in far more than a doubling of airplane weights. The development of long-range aircraft or aircraft with large pay loads entails the practical solution of a slowly converging series, since both structural and aerodynamic efficiency tend to stabilize with increasing size. Demands for more horsepower grow ever higher because of physical limitations on size of operating bases and the requirement for an increasing level of performance; these factors combine to require more fuel, more armament, more crew members, and thus more cumulative difficulties in overall design with increasing size.

In the XB-42 a big step was planned in aerodynamic, structural, and power-plant efficiency which would result in a drastic reduction in airplane size for a given range or bomb load. With high aerodynamic, structural, and power-plant efficiency, it appeared that it should be possible to develop a small, high-speed, versatile airplane capable of being maintained and operated by a small crew, using only a relatively small amount of fuel (thus helping pressure on military transport), requiring only minimum armament because of its speed, and requiring comparatively small plant facilities for high production.

With such a small airplane, a multiplicity of military duties could be assigned to the airplane, moving from long-range bombing to short-range, high-capacity bombing to ground attack, and ground support to reconnaissance, as the military situation demanded.

General Design

An airplane with good flying characteristics was desired, with particular attention paid to safety and ease of flying after engine failure. Some type of "centerline" thrust design was indicated to eliminate the critical period that is encountered upon failure of one engine in a conventional highly powered multiengined airplane.

Conventional multiengined airplanes have continually improved in efficiency with the development of cowled engines, cantilever structure, smooth finish, low drag shapes, and better propellers. The problem in the XB-42 was to improve on convention and, at the same time, eliminate disadvantages inherent in the conventional arrangement, such as slipstream over surfaces, profile drag of exposed nacelles, instability tendencies with power-on due to propeller location forward of the center of gravity, and control troubles under partial engine conditions. Partial solution could be found in a pusher-type configuration with engines in the wings, but structural, cooling, control, and propeller vibration difficulties (particularly with flaps down) eliminated this from consideration.

The success of the Bell P-39 shaft drive led to the conclusion that such a drive system was suitable for further development and, together with liquid-cooled engines, provided the key to our demands in the XB-42. What was envisaged was a completely clean wing, enclosing the engine radiators and cooling system, fuel, and possibly armament; a fuselage as shown in Fig. 1 enclosing the crew, bomb bay, engines, and equipment; a set of tail surfaces; and remotely driven propellers providing "centerline" thrust *behind* the tail surfaces. From this configuration it appears that we have a completely functional configuration of the cleanest possible type, with no excrescences due to power plant or other

Presented at the Aircraft Design Session, Annual Summer Meeting, Los Angeles, July 18–19, 1946.

* Chief, Preliminary Design Section, Santa Monica Engineering Division.

miscellaneous items, with no slipstream problems, with added stability from propeller action, and with excellent vision and low sound level. The various major components of the airplane can be kept simple and straightforward and thus efficient and low in production cost.

General Requirements

Study of the overall configuration established the general geometric requirements of the airplane to be able to carry 2,000 lbs. of bombs for an absolute range of more than 5,000 miles and to have a high speed in excess of 400 m.p.h., together with a maximum internal bomb capacity of 8,000 lbs. (whether in U.S. 2,000-lb. bombs, British 4,000-lb. bombs, or British 8,000-lb. bombs). Naturally, at the same time, good take-off, flying, and landing characteristics were required.

Production Time

Thus far the XB-42 has been considered in generalities. The various problems encountered and solved during the design should be of interest.

The first problem was that of time. The first, and rather informal, proposal was made to the Army in May, 1943. It was June, 1943, by the time a specification was agreed upon. A contract finally was awarded in August, 1943. XB-42 No. 1 flew on May 6, 1944, a year from initial presentation of the idea to the Army and less than 10 months from the start of actual design, which is believed to be a design and construction time as short as any for a modern bomber with all of its complications.

General Arrangement

The next problems were those of general arrangement. The arrangement problem in the XB-42 was approached as follows: the wing and tail were positioned in space relative to each other so that acceptable stability and control characteristics would be attained. The propellers were then properly located behind the tail surfaces, and these three items were then treated as one unit for arrangement purposes. The best possible packaging job was then done on another group comprising the bomb bay, miscellaneous equipment, and engines and crew, this group then being considered as another unit and juggled against the first group to determine the final configuration, except for the inevitable small final adjustments.

The one particular configuration problem was that of the main landing gear. The proper position of the bomb bay with respect to the wing, combined with the relative thinness of the wing and the desire for reservation of space in the inboard portion of the wing for engine cooling, required retraction of the landing gear into the fuselage aft of the bomb bay. The landing gear produced no particular design problems of itself. However, this long landing gear retracting aft into the fuselage had great effect on the balance problems of the airplane. The basic arrangement of the airplane, when approached as outlined above, came out to be simple and straightforward with promise of good military utility.

Aerodynamic Problems

The next general class of design problems was aerodynamic. Normal items such as selection of wing sections, correlation of wing plan form and angles for good low-speed flight characteristics, and positioning of the tail surfaces with respect to the wing were solved in the normal course of business.

The particular aerodynamic problems arising because of the airplane type were sometimes surprising. For example, with the XB-42 configuration, no particular trouble was experienced with stability, but considerable trouble was experienced with control. With propellers at the aft end of the fuselage the power-on stability was naturally greater than the power-off stability. The power-off stability rear limit normally lies between 40 and 45 per cent of the M.A.C., and, although the exact zero-stability point on the XB-42 was never found, there are indications that the power-on aft limit was probably somewhat behind 50 per cent of the M.A.C. If full advantage could have been taken of

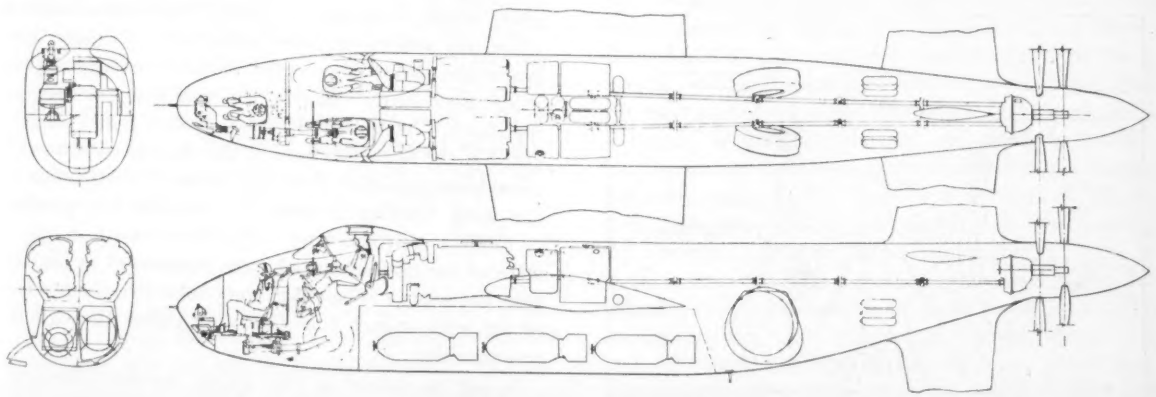


Fig. 1. Inboard profile and cross section.

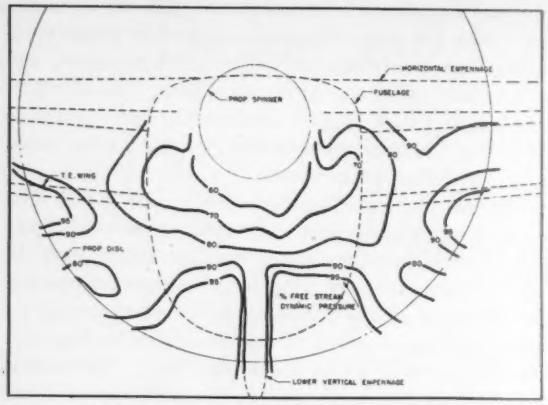


FIG. 2. Wake picture. Wing and tail surfaces, flaps retracted, gear down.

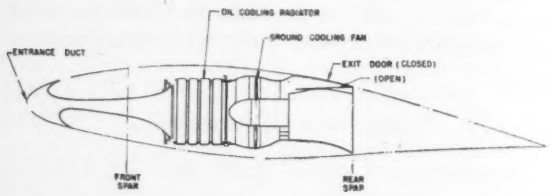


FIG. 3. Section through wing cooling duct—open and closed.

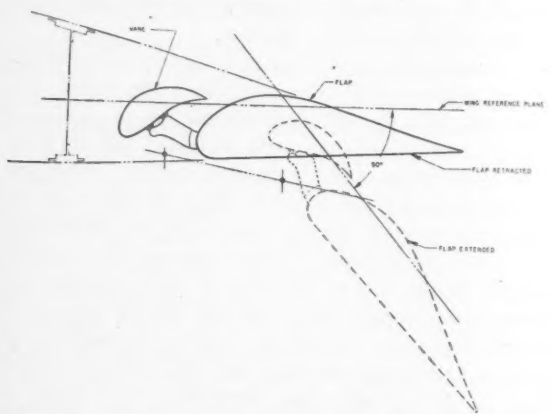


FIG. 4. Section through wing showing flaps up and down.

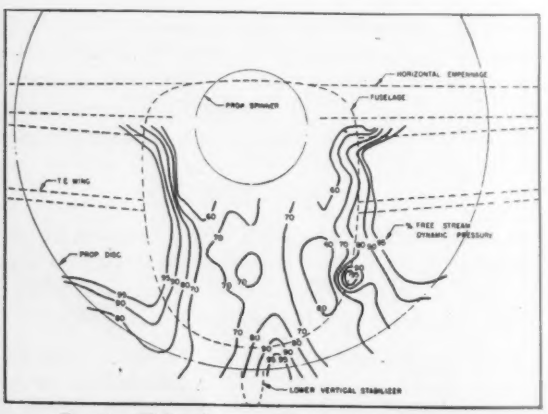


FIG. 5. Wake picture. Flaps extended, gear up.

this aft stability limit in the loading of the airplane, many of the resulting control problems could have been eliminated, but flight-test personnel felt that the airplane would have questionable spinning characteristics if the center of gravity was allowed to go behind 35 per cent of the M.A.C. With this as a control point, the airplane had to be designed for a forward center-of-gravity limit of the order of 20 per cent M.A.C., and this, combined with the relatively high vertical position of the center of gravity with respect to the landing gear (required because of necessity for bomb clearance under the airplane) which forced the position of the main landing wheels considerably aft, caused nose-wheel lift-off to become a major problem in the design of the airplane. As the combination of fixed horizontal surface and propellers provided the equivalent of two fixed surface areas with only one set of elevators, this nose-wheel lift-off problem was one of the basic problems throughout the whole design and development period of the airplane and, as yet, has not been fully solved, although the situation was improved by increasing the elevators in size, and data were obtained that will permit reasonable nose-wheel lift-off characteristics in any new airplanes of this general type.

The other basic problem was that of control in yaw, again because high stability, this time directional in type, combined with more-or-less normal control. The contribution of the propellers to stability in yaw was considerably more than to stability in pitch because of the absence of down-wash from the wings. The solution to this problem was also only approached and consisted of increasing the size of the rudder surfaces. Again basic information was obtained that will permit the establishment of proper configuration in any new design.

The next major aerodynamic problem was that of propeller vibration. Propeller vibration arose from four primary sources, which will be mentioned in order of increasing importance. The first, and of practically negligible importance, was that arising from the wake of the wing and tail surfaces, and it was found that it produced no particular vibration of the propeller. The next least important source of propeller vibration was the wake shown in Fig. 2 from the extended landing gear, which, although noticeable, was not enough to cause any serious propeller vibration. The next least important source of propeller vibration came from two interrelated items—namely, the wing flap and the cooling doors. As shown in Fig. 3, cooling doors were located in the upper portions of the wing to obtain maximum pumping effect from the pressure distribution on the wing, opening inwards to minimize any spoilage of the flow over the wing. The flaps, shown in Fig. 4, were of the double-slotted type, suspended by linkage from the wing. When flaps were deflected, the position of the wing is such that the wake passes through the propeller disc.

It will be noticed in Fig. 5 that the wake from the extended flaps is powerful at the propeller disc. Al-

though this induced considerable vibration, there was no question of any propeller structural failure at the speeds at which flaps are in operation or at which the cooling doors are open.

The major source of propeller vibration was found to be from the wake of the open bomb bay. As shown in Fig. 6, when the bomb bay is open there is a cavity as wide as the airplane, half as deep as the fuselage, and 40 per cent of the length of the airplane. As the bomb bay must be openable at any flight speed up to the placard limits of the airplane, this source of vibration may be extremely serious. The extreme power of the wake can be seen in Fig. 7. The wake was found to be subject to some control by eliminating air spillage at the rear of the bomb bay by means of slots and reshaping. The other means taken were to minimize the effects of the wake by the use of snap-action bomb doors, thus shortening the critical period of open bomb bay, and by dynamic mounting of the aft gear box to minimize the effects of the vibration both on the propellers and the airplane. From the information gained in the investigation of the above vibration problems, it is believed that any future airplanes will have only routine troubles from this source.

The remaining aerodynamic problems were generally confined to control surface balance and ducting. Internal sealed balances were used on the control surfaces, and troubles were generally routine in the provision of suitable amounts of balance to give desirable hinge moment characteristics throughout the wide speed range of the airplane. The troubles were concentrated in the aileron system, where they were compounded by the fact that the experimental airplane had a control system with excessive friction. This situation could not be corrected in the XB-42 because of lack of time but has been corrected in the XB-43, which was developed from the earlier airplane.

The ducting work was on two systems, engine induction and cooling. For the first time in our knowledge, flush-type scoops were used in the engine induction system, and the problems involved were solved by the provision of suitable boundary layer bleeds in the ducts. The cooling duct problem was complicated by the fact that the arrangement requirements of the airplane dictated that the cooling system be placed in the wings. Development of suitable ducting was concentrated on the provision of proper flow for cooling with minimum drag and proper external flow over the wing so that minimum penalty was paid in wing drag and wing lift. The duct development moved progressively from the initial type to the final type as shown in Fig. 8.

Power-Plant Installation

The power-plant installation, although it was by far the most radical single item in the XB-42, presented surprisingly few difficult problems, primarily because of the deliberate attempt to make the power-plant installation merely an unconventional arrangement of conventional components. Fig. 9 indicates the general

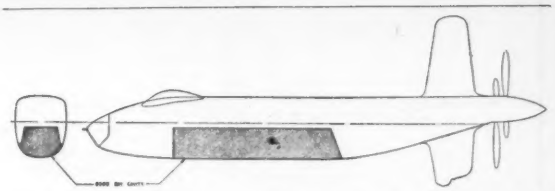


FIG. 6. Longitudinal section showing extent of bomb bay.

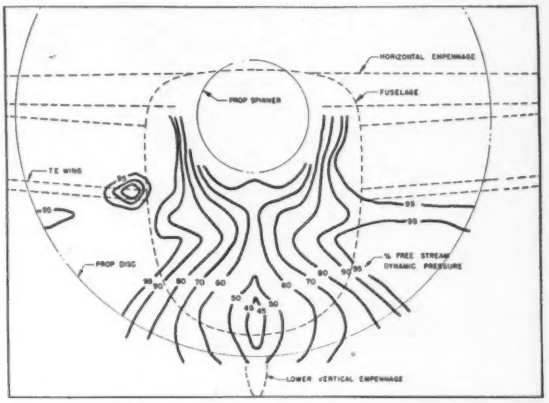


FIG. 7. Wake picture. Only bomb bay open.

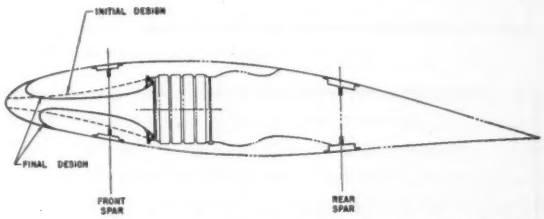


FIG. 8. Section through wing showing initial and final design of radiator ducts.

arrangement. Two Allison V-1710 engines were installed immediately behind the pilot's compartment, with the centerline of each engine at about 20° to the vertical and the engines toed-in a few degrees to the rear. Power was transmitted from each engine to its own propeller through six lengths of shafting, each length identical to that used in the Bell P-39 airplanes. Gear reduction and final drive were through a modified V-3420 counterrotation gear box to Curtiss right- and left-hand pusher propellers that were especially modified to permit individual governing and separate control. No trouble has ever been encountered from the engine and drive system. The shafts and bearings all appear to be in excellent shape after more than 600 hours on the test stand and over 150 hours of flight.

Aside from the duct problems mentioned above, no difficulty was encountered in flight operation of the cooling system, but considerable development was necessary on the ground cooling system. No airflow was available for ground cooling because of the location of the propellers behind the tail, and accordingly ground cooling fans were necessary. One electrically driven

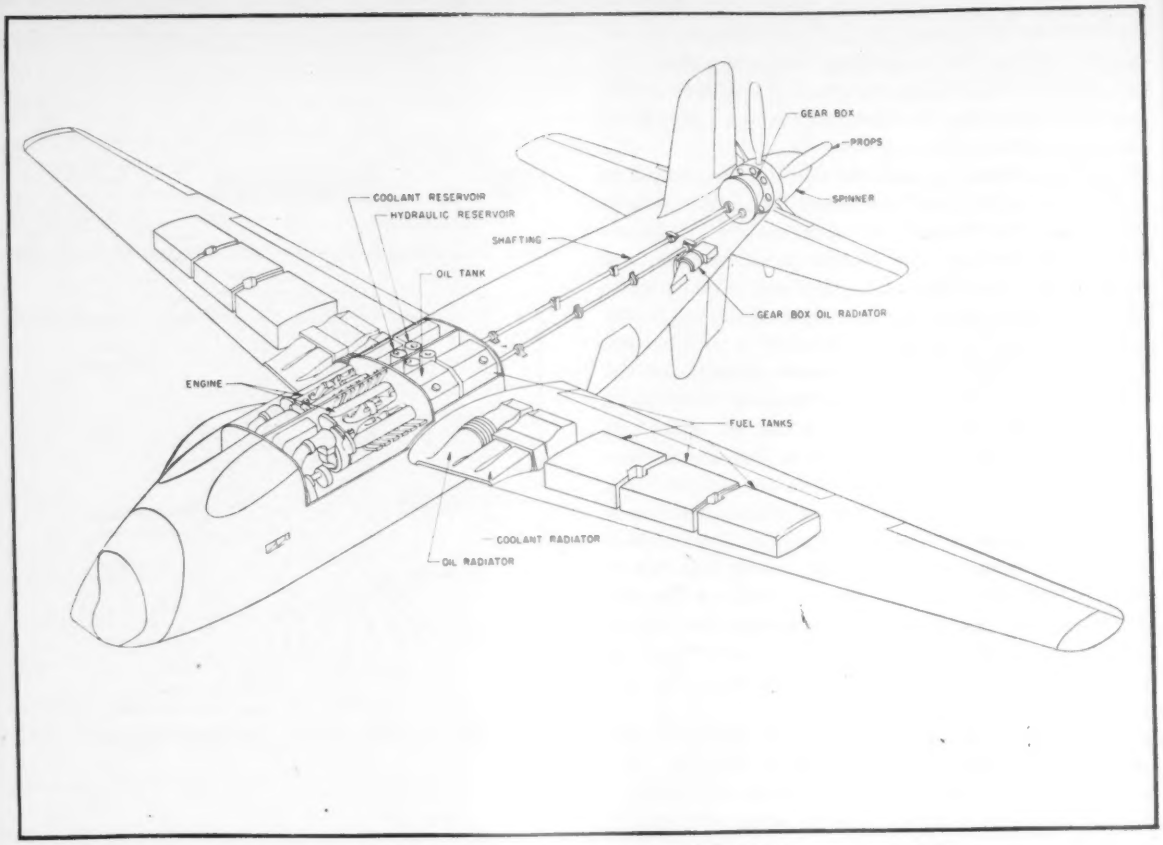


FIG. 9. Diagrammatic sketch of power plant, engines, cooling, shafting, props, gear box, etc.

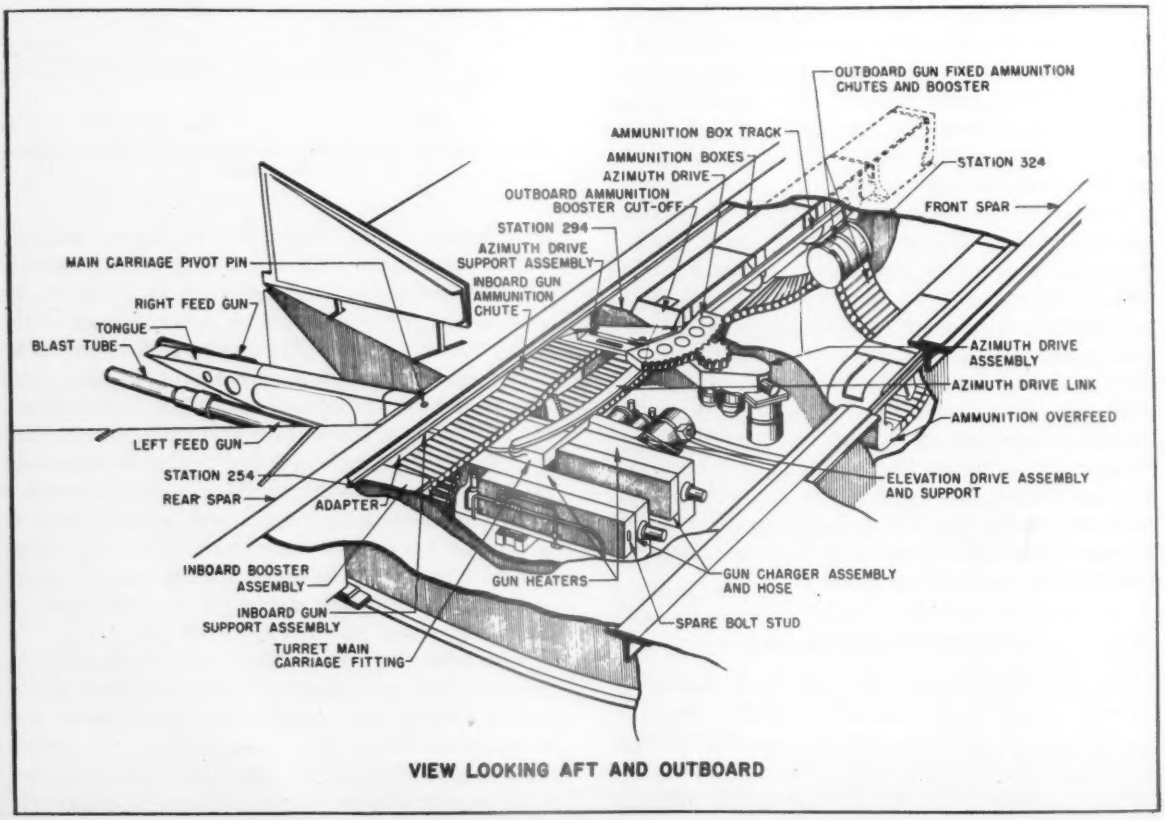


FIG. 10. Diagram of wing turret.

fan was provided for the Prestone cooler for each engine, as well as one for the oil cooler for each engine, a total of four in all. The final control system for operation of the ground cooling fans provided that electrical energy be supplied from the battery and generators individually for each engine when the weight of the airplane was on the nose gear while the oil pressure of the particular engine exceeded 15 lbs. per sq.in. Considerable development was required to obtain fan motors that would not burn out, and this turned into a development of suitable cooling and venting provisions for the individual motors. No trouble has been reported from the ground cooling system since October, 1944.

Mechanical Installations

Mechanically, the XB-42 presented only routine design problems except for the armament. As the airplane is small and fast, it appeared from complete analysis of possible attack techniques that the only defensive fire power required would be in a rather limited zone to the rear of the airplane. The presence of the propellers at the tail of the airplane complicated the issue. Decision was made to proceed with a wing installation, which developed nicely. The resulting installation is shown in Fig. 10. The cover doors were of the snap-action type and, in tests up to the airplane design speed, were found to have no deleterious effect on flutter or control, the only noticeable effect being a slight increase in directional stability when the doors were open. No objectionable vibration of the wing or controls was found from the gun recoil, and the gunfire pattern appears to be good.

Design of equipment installations presented only routine problems aside from those connected with the ground cooling mentioned above.

Problems encountered in structural design were different from normal but were not too difficult. Most fuselage development centered around the development of stressed but quickly openable engine compartment doors by the use of specially designed quick-acting fasteners, capable of taking shear and tension loads, and on the design of snap-acting bomb doors. The latter were a problem because of the large size of the doors (20 ft. long and clear across the fuselage). The structure around the engine compartments was made of stainless steel where internal, but otherwise was normal. It is felt that the provisions for the engines and related items such as shafting were simpler of accomplishment than on a normal airplane. Wing problems were straightforward except for the necessary structural provisions for large ducts in the radiator location; long span between ribs in the fuel tank section, together with easily removable tank covers; and the use of the spars to carry torsional loads across the section where the guns were installed. From a structural criteria standpoint most of the work encountered was the correction of normal criteria for Mach Number effects, together

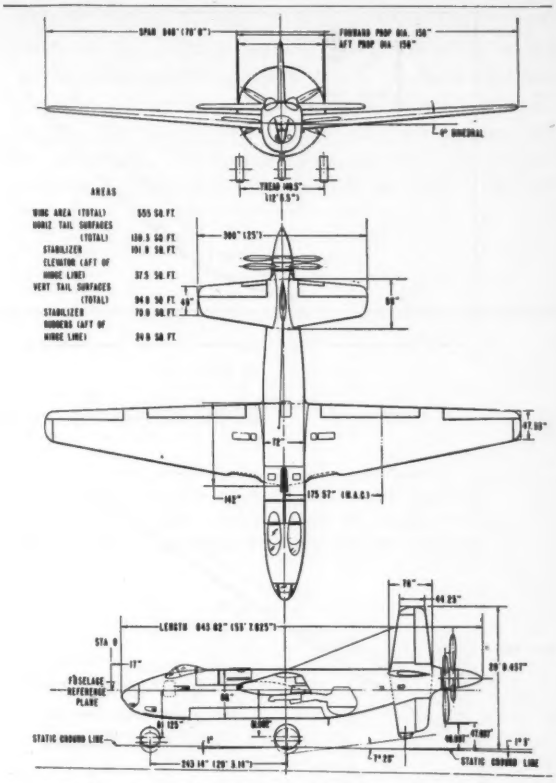


Fig. 11. Three-view drawing with dimensions and areas.

with the determination of the critical conditions for the airplane whether it was being used as an attack airplane at light weights or as a bomber at heavy weights. The final means for placarding the airplane in flight makes use of both a Mach meter and an air speed, the indicated air speed being critical up to about 17,000 ft. and the Mach Number being critical above that altitude.

One problem arose that may be of interest—the mounting of the final drive gear box. This was accomplished by pressing a frame out of 5/32 aluminum alloy to which the gear box mounting ring was bolted. The question was raised early in the design as to how the crew would be able to get out of the airplane in case of emergency. It was decided that the best thing to do would be to arrange for the jettisoning of the propellers. The final solution for jettisoning was to drill a series of holes through the frame mentioned above and then provide a holder with a piece of cordite that could be exploded by separately closing both sides of a detonating circuit. This frees the propellers and gear box from the airplane, the drive shafts slipping out of their splined connections at the gear box, and the whole gear box and propeller assembly comes off the airplane.

Conclusions

Vibration problems were discussed earlier. High-speed airplanes bring in flutter problems, but up through the design speeds of the XB-42 it appears that our usual method of providing element-by-element

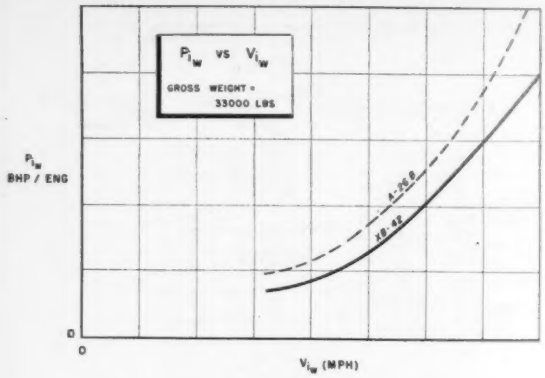


FIG. 12.

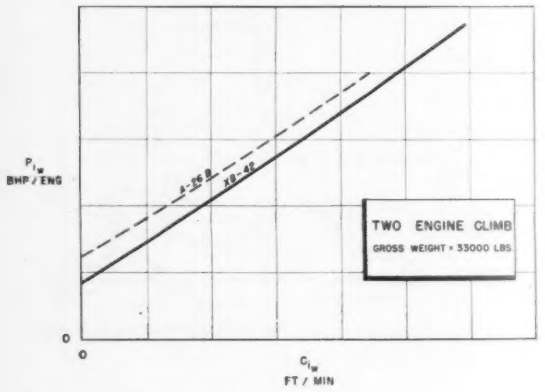


FIG. 13.

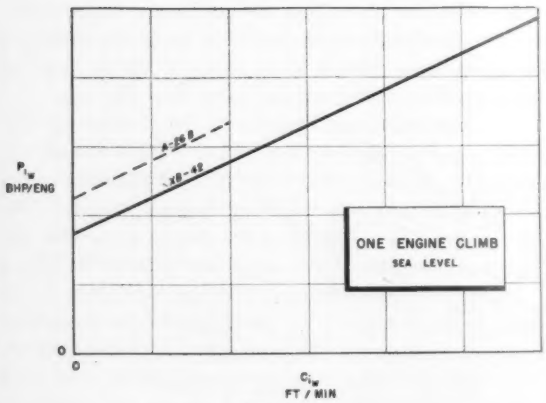


FIG. 14.

static balance of all control surfaces, with a conventional control system, is perfectly adequate for flutter control.

On the design and development of any airplane the best thing that can be stated and shown are the final characteristics of the airplane as found in flight. The three-view drawing in Fig. 11 indicates the really small size of the airplane considering that it has a speed of well over 400 m.p.h., a range with 2,000 lbs. of bombs of well over 5,000 miles, and a bomb capacity of 8,000 lbs.

Presentation of performance information in a discussion such as this may be confusing because it cannot be complete. The A-26 developed by Douglas has almost the identical span and wing area as the XB-42 and thus is used for purposes of comparing the conventional and unconventional airplane types. From the speed standpoint, Fig. 12 shows the comparative variation of power and speed for the two airplanes. Two climb curves are given, that in Fig. 13 for two-engined operation and that in Fig. 14 for single-engined operation. Specific take-off curves are also shown for the two airplanes in Fig. 15. Specific range curves are given at comparable weights for the two airplanes in Fig. 16.

During flight test the speeds checked the predictions within 1 per cent and checked a drag saving of about 30 per cent for the XB-42 over comparable conventional designs. The range figures came out somewhat better than predicted because of the improvement in span efficiency arising from the absolutely clean wing. The climb came out somewhat better than expected, being well up for two-engined operation and being about 35 per cent high for single-engined operation, this latter due to higher span efficiency, reduction of drag due to lack of off-center thrust and its resulting

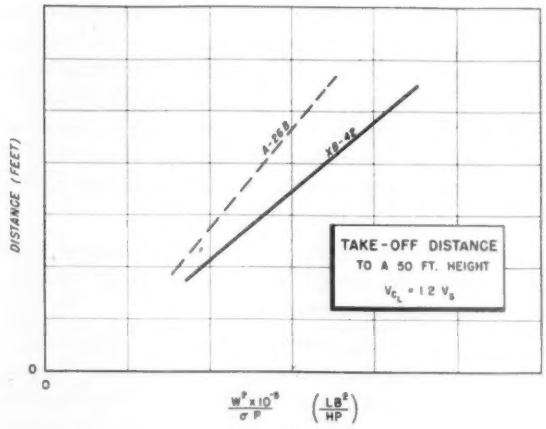


FIG. 15.

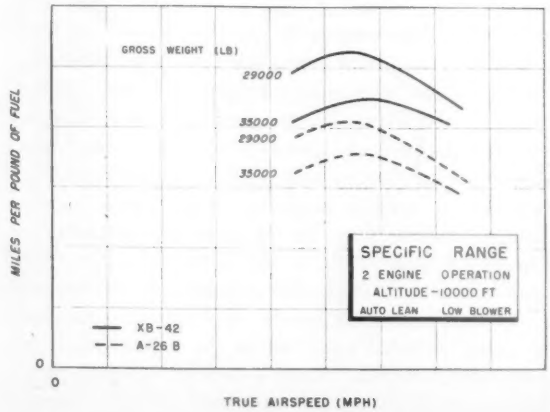


FIG. 16.

high control surface drag, and location of the propellers in an advantageous position that promoted high efficiency during take-off and climb.

Official delivery of the airplane to the Army was made in a transcontinental flight from Long Beach, Calif., to Washington, D.C., on December 8, 1945. The delivery was successfully performed in an elapsed time of 5 hours, 17 min., 34 sec., a distance of 2,295 air miles at an average ground speed of 433.6 m.p.h. Allowing for an average of 60 m.p.h winds in existence, the true average air speed for the flight was about 375 m.p.h. For this flight, 1,153 gal. of gasoline were used, or an average of about 2 miles per gal., the airplane landing with 305 gal. of fuel left in its tanks.

I.A.S. Meeting Preprints

A limited number of copies of preprints of papers presented at meetings of the Institute are available for distribution, at a charge of 25 cents each to members of the Institute, and 50 cents to nonmembers, to cover handling and mailing charges. The following lists the preprints available from the past four national meetings of the Institute. Preprints may be ordered by number.

Aircraft Propulsion Meeting—Cleveland, Ohio, March 21, 1946

15. Application of Axial Compressors in Aeronautics—Ens. F. J. Gardiner, United States Naval Reserve, Navy Department, Bureau of Aeronautics. 11 pages; 8 illus. (Typewritten and photo-offset.)

Light Aircraft Meeting—Detroit, Mich., June 13–14, 1946

18. Maintenance of Personal Aircraft—George H. Weitz, Chief, Air Frame Section, Non-Scheduled Aircraft Maintenance Division, Civil Aeronautics Administration. 7 pages; no illus. (Mimeographed.)

Annual Summer Meeting—Los Angeles, Calif., July 18–19, 1946

20. Engineering Aspects of the Development of the Rainbow—Alexander Kartveli, Vice-President and Chief Engineer, Republic Aviation Corporation. 68 pages; 61 illus. (Vari-typed and photo-offset). *Available without charge from Republic Aviation Corporation.*

National Air Transport Meeting—Washington, D.C., October 24, 1946

26. The Application of Microwaves to Instrument Landing of Airplanes—Joseph Lyman, Aircraft Radio Research Engineer, Sperry Gyroscope Company, Inc. 34 pages; 27 illus. (Photo-offset.)

27. Development of International Standards for Airworthiness of Transport Aircraft—Paul A. Puvrez, Expert, Airworthiness Division, Provisional International Civil Aviation Organization (PICAO). 9 pages; no illus. (Photo-offset.)

28. Air Conditioning of Transport Aircraft for Year Around Comfort in Flight and on the Ground—Bruce E. Del Mar, Mechanical Test Engineer, Santa Monica Engineering Division, Douglas Aircraft Company, Inc. 10 pages; 10 illus. (Photo-offset.)

29. Teleran for Air Navigation and Traffic Control—L. F. Jones, Manager, Research & Development Projects, Radio Corporation of America. 24 pages, bound in covers; 17 illus. (Printed.)

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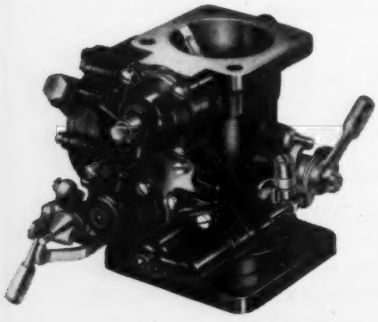

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Aeronautical Reviews

An Improved Review Service

With this issue of the AERONAUTICAL ENGINEERING REVIEW, a noteworthy change in format and policy in the following Section has been adopted. These changes have been made with but one objective—to broaden the scope of the REVIEW coverage and render a more valuable service to all of its readers.

A two-column page, in place of the three columns previously used, has been adopted, along with a slightly smaller type, primarily to gain space for the inclusion of additional abstracts. This also provides a more practical style format for those individuals who find it useful to clip and paste items on 3″ × 5″ library index cards.

Of primary importance, however, is the improvement in the general method of screening, selecting, abstracting, and listing the various items. Well-qualified members of the Institute library staff are assisting the REVIEW editors in evaluating material for review purposes. Persons accustomed to using the REVIEW will find numerous departures from precedents, in addition to a wider coverage of subjects.

The objectives sought for in this and subsequent issues are:

1) To screen all publications, periodicals, reports, or releases published in the United States or abroad as rapidly as they are received.
2) To review, abstract, or list every item of interest to engineers or scientists in the field of aeronautics.
3) To give complete bibliographical information on each item.
4) To include enough information in the abstract or summary to enable the reader to evaluate the original article and to determine his further interest in it.

It is our hope and intention to improve this service with each succeeding issue. Comments and constructive criticism from our readers will assist us in this objective and will always be welcome.

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Aerodynamics

The Interaction Between Boundary Layer and Shock Waves in Transonic Flow. Hans-Wolfgang Liepmann. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, pp. 623–637, illus. 5 references.

Experiments of transonic flow past a circular arc profile show that the shock wave pattern and the pressure distribution are strongly dependent upon the state of the boundary layer. A change from laminar to turbulent boundary layer at a given Mach Number changes the flow pattern considerably. Shock waves can interact with the boundary layer in a manner similar to a reflection from a free jet boundary. These shock waves are not distinctly discernible from pressure-distribution measurements.

The Supersonic Theory of Wings of Finite Span. M. J. Lighthill. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2001*, October 2, 1944. 15 pp., figs. 6 references. British Information Services, New York. $0.90.

Using the previous work of Schlichting but working from a different point of view, a general theory of wings of finite span whose cross section is constant along the span, is set out. Opportunity is taken to outline all developments of the supersonic theory, along the lines of the "linearized equation," which have hitherto been made. Every effort has been made to clarify the physical and mathematical bases of the theory. It is found that for a rectangular wing of aspect ratio A, at Mach Number M the effective angle of incidence is reduced by a factor expressed as $1 - [0.5/(A\sqrt{M^2 - 1})]$; but there is no induced drag.

For a wing of trapezoidal plan, the longer side facing the stream, there would be no change in lift or drag for sufficiently high Mach Numbers; they would be the same (related to the wing area) as for two-dimensional flow. However, this modification may not be worth making in practice, seeing that the reduction factor mentioned is so little less than unity.

Superaerodynamics; Mechanics of Rarefied Gases. Hsue-Shen Tsien. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, pp. 653–664, figs. 25 references.

The fundamental concepts of a new branch of fluid mechanics, designated as superaerodynamics, are discussed. The theory refers to the aerodynamics of higher rarefied gases, a subject that was formerly in the field of academic interest rather than of practical engineering importance but which has now taken on greater practical interest through the recent progress of the rocket as a propulsive power unit and the great altitudes now being reached by rockets. After explaining the molecular structure of gases and the nature of gas flow, a mathematical treatment is given of the stresses and boundary conditions in slip flow with regard to both high and low Mach Numbers, as well as free molecule flows at small and large Mach Numbers. Mathematical expressions are derived for the computation of these values, taking into consideration the variations in temperature and other variable conditions affecting the results.

Notes on the Stalling Properties of Wings. E. J. Richards. *The Royal Aeronautical Society, Journal*, Vol. 50, No. 431, November, 1946, pp. 888–892, figs.

Consideration is given to the growth of the boundary layer over an airfoil at high incidence. It is found that three types of boundary layer separation will occur, these depending on the Reynolds Number and the actual adverse gradient. Types of stall caused by laminar separation, sudden turbulent separation, and slow turbulent separation are discussed. How stalling characteristics are affected by the Reynolds Number, thickness-chord ratios, leading-edge radius of curvature, and sweepback is described.

Experiments on a Model "Falcon" Aeroplane With Wings of Standard and High Taper. H. B. Irving, A. S. Batson, J. H. Warsap, and H. J. Gummer. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2018*, November 20, 1939. 35 pp., figs. 5 references. British Information Services, New York. $1.90.

The experiments reported were made with a dual purpose, the first being the collection of model data on the stability and control of a typical low-wing monoplane; the second, the determination of the effects of wing brake flaps, tip slots, and variation of taper on the stability and control characteristics of the model as compared with their effects on the full-scale behavior of the airplane, particularly in the region of the stall. Besides measurements of lift, pitching, rolling and yawing moments, the experiments included a determination of the nature of the flow over the standard and high-taper wings of the model in the region of the stall by means of wool tufts placed both on the surface and above it on "masts."

The results of the model tests for normal flying incidence are, on the whole, in accordance with the full-scale behavior, although not always precisely so. In the region of the stall, however, although the nature of the stall appears to be broadly the same on the model as on the full scale, the model tests seem to be an uncertain guide, either directly to full-scale behavior or comparatively to the effects of such features as taper and brake flaps. Actually, the model and full-scale results accorded fairly well as regards the effect of taper on the rolling properties near the stall of the machine without flaps, but on the flap-equipped model with standard taper there was a double maximum in the lift curve of which there was no evidence on the full scale. Model rolling-balance tests indicated an adverse effect of flaps on rolling stability near the stall, which also was not borne out by the full-scale tests. Further, on the full scale, the flaps caused a pitching oscillation at the stall of which the model gave no indication.

Below the stall, model and full-scale tests agreed in showing that lowering the flaps and increasing the taper had no important effects on longitudinal trim, elevator, aileron, and rudder control. On the other hand, lowering the flaps appreciably reduced the rolling moment due to sideslip—or, in other words, reduced the effective dihedral; and, in the case of the high taper, made it positive (unstable). Although the geometric dihedral of both machines was 5°, the effective dihedral of the high-taper machine (flaps up) was practically zero; this was found to be the result mainly of a body-wing interference, and partly the result of the high taper.

Newton and Fluid Mechanics. J. C. Hunsaker. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, pp. 647–652, figs.

In a paper presented at the Newton Tercentenary Celebration, sponsored by the Royal Society at Cambridge University, the Director of the National Advisory Committee for Aeronautics traces the connection of the fundamental concepts of Newton with the development of the science of aerodynamics. He shows how other early scientists applied and expanded the theories of Newton, and how Newton's laws form the basis of much of the aeronautical progress of the present time, as well as constituting the foundation of the entire structure of engineering. Leaving aside compressible and supersonic flows, the writer outlines how the two great branches of fluid mechanics—frictionless flow and viscous flow—each starting with Newton, have independently developed over three centuries and have now been brought together as a powerful instrument of aeronautical science. He reviews the development of the laminar-flow or low-drag wing, tracing the con-

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

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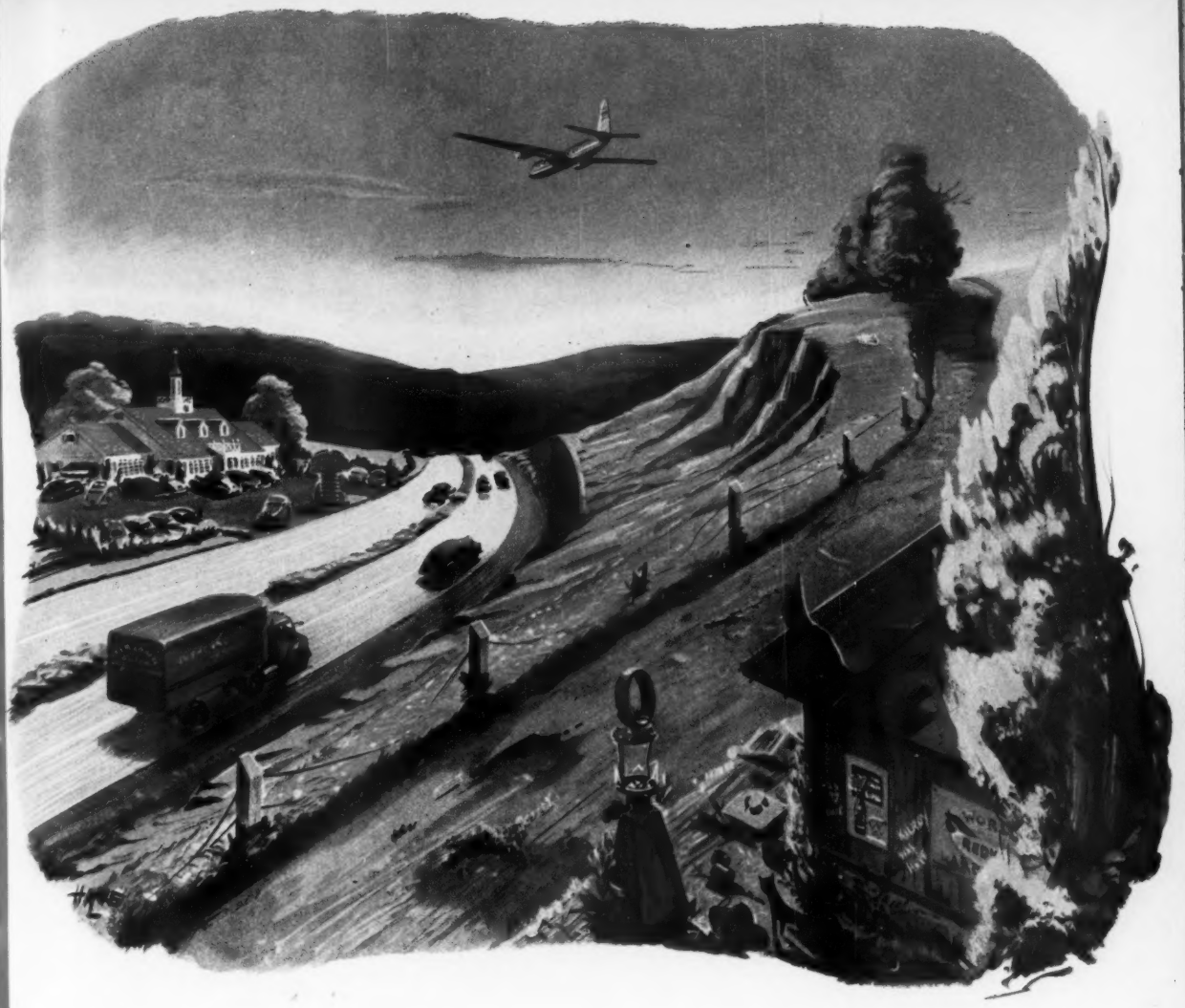

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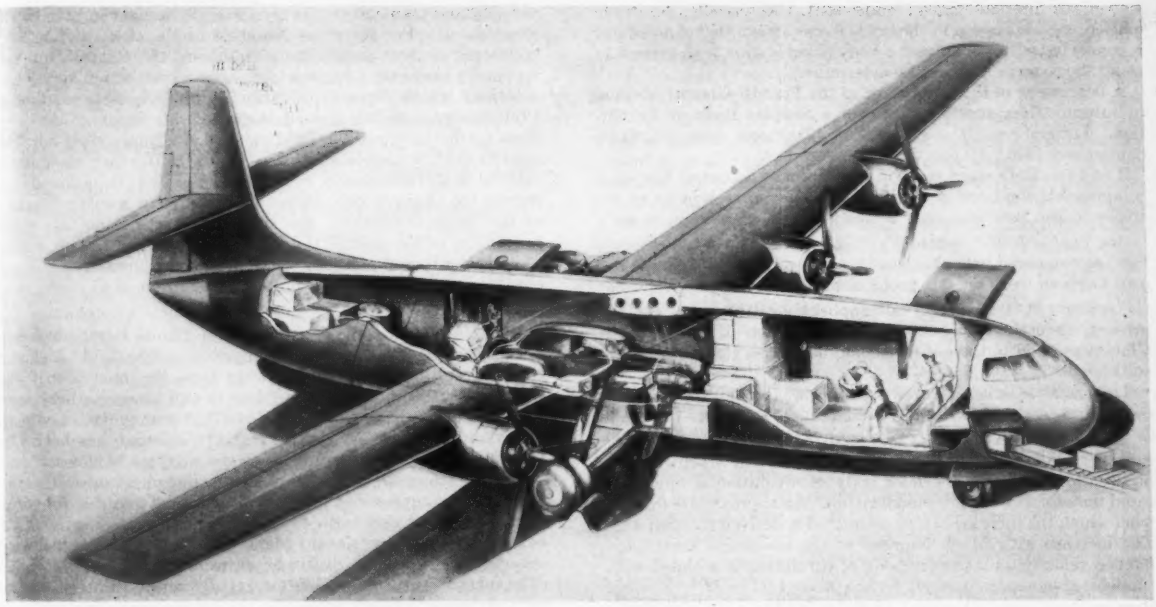

Cutaway view of the Curtiss-Wright CW-32 cargo airplane. (See page 39.)

tributions of the early investigators and those of contemporary engineers, and describes the work done in the Langley Memorial Laboratory of the N.A.C.A.

Flow Tests of an NACA-Designed Supercharger Inlet Elbow and the Effects of Various Components on the Flow Characteristics at the Elbow Outlet. D. C. Guentert, D. J. Todd, and W. P. Simmons, Jr. *U.S., N.A.C.A., Technical Note No. 1148*, October, 1946. 26 pp., figs. 2 references.

An investigation was conducted on a supercharger inlet elbow designed by the N.A.C.A. to have a uniform velocity distribution at the outlet with a minimum pressure loss through the bend. The effects of a vane, installed normal to the plane of the bend, an impeller-shaft housing, and the combination of the two on the outlet-velocity distribution and the total pressure drop through the elbow were determined. In addition, the effect of streamlining the impeller-shaft housing and the effect of carburetor-throttle position on the flow characteristics at the elbow outlet were investigated.

The results showed that the outlet-velocity profile was uniform and the total-pressure-drop factor of the elbow was approximately 0.05 at a Mach Number of 0.28 as compared with 0.5 for the best conventional elbow previously tested. The addition of the vane in the elbow without the housing and carburetor improved the outlet-velocity distribution and lowered the total-pressure-drop factor of the elbow from approximately 0.05 to 0.03 at a Mach Number of 0.28. The installation of the impeller-shaft housing in the elbow without the vane and carburetor slightly distorted the outlet-velocity profile and caused an increase in the total-pressure-drop factor from approximately 0.05 to 0.08 at a Mach Number of 0.28. Streamlining the shaft housing somewhat reduced this flow disturbance. The addition of the vane to the elbow with the streamlined housing and without the carburetor improved the outlet-velocity profile but increased the total-pressure-drop factor of the elbow from approximately 0.08 to 0.1 at a Mach Number of 0.28. This distortion caused by the throttle continuously increased as the throttle was closed from the full-open position. The addition of the vane in the carburetor-elbow assembly had a detrimental effect upon the outlet-velocity profile.

The Approximate Calculation of the Lift of Symmetrical Aerofoils Taking Account of the Boundary Layer, with Application to Control Problems. J. H. Preston. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 1996*, May 20, 1943. 44 pp., figs., tables. 14 references. British Information Services, New York. $2.25.

Model experiments have demonstrated that the large effects of boundary layers on control hinge moments are associated with changes in circulation around the airfoil, so that any theory must first aim at the calculation of these changes. The theorem that equal positive and negative amounts of vorticity must pass into the wake at the trailing edge in the steady state was used as a basis in the calculations.

Following certain first approximations, empiric corrections for the original assumptions were tried. The theory was made the basis of an exploration of the probable effects of position of transition point, of Reynolds Number, and of Mach Number on lift and hinge moments. Potential-flow theory was applied to calculate the effect of small obstructions at the trailing edge in an attempt to explain the large effect of such obstructions on circulation and on hinge moments. Results of three approximations are given. The marked effect of wires or cords on the NACA 0020 as opposed to their small effect on the NACA 0010 is brought out. The quantitative prediction of the effect of trailing-edge strips on circulation will fail unless account can be taken of the separation of the flow on the downstream end of the strip as well as of the local velocity field surrounding the strip. The observed effects can, however, be readily explained in broad outline on the basis of the theory developed in this paper.

A sudden movement of the transition point from its natural position on the upper surface to the nose at 3° incidence was shown to produce a kink in the calculated lift curve of NACA 0020 which is similar to that observed on some low-drag airfoils. This kink is reflected violently in the predicted hinge-moment curve, where underbalance below 3° is changed to overbalance above 3°. A similar calculation for a cusped Joukowski airfoil showed a negligible effect of an even greater transition movement. The effects of Reynolds Number and of Mach Number are explained with reference to the values stipulated in the text. Comments are made concerning the further investigations that would be undertaken to establish more firmly some of the assumptions brought out in the report.

Application of the Method of Characteristics to Supersonic Rotational Flow. Antonio Ferri. *U.S., N.A.C.A., Technical Note No. 1135*, September, 1946. 41 pp., figs. 12 references.

A system for calculating the physical properties of supersonic rotational flow with axial symmetry and supersonic rotational flow in a two-dimensional field was determined by use of the characteristics method. The system was applied to the study of external and internal flow for supersonic inlets with axial symmetry. For a circular conical inlet the shock that occurred at the lip of the inlet became stronger as it approached the axis of the inlet and became a normal shock at the axis. The region for which strong shock occurred increased with the increase of the angle of internal cone at the lip of the inlet. For an inlet with a central body the method of characteristics was applied to the de-

sign of an internal-channel shape that, theoretically, results in efficient recompression in the inlet; it was shown that if an effuser is connected with the diffuser a body of revolution with extremely small shock-wave drag can be determined.

A Discussion of the Application of the Prandtl-Glauert Method to Subsonic Compressible Flow over a Slender Body of Revolution. Lester Lees. *U.S., N.A.C.A., Technical Note No. 1127*, September, 1946. 19 pp., figs. 14 references.

The Prandtl-Glauert method for subsonic potential flow of a compressible fluid has generally been believed to lead to an increase in the pressures over a slender body of revolution by a factor $1/\sqrt{1-M_1^2}$ (where M_1 is Mach Number in undisturbed flow) as compared with the pressures in incompressible flow. Recent German work on this problem has indicated, however, that the factor $1/\sqrt{1-M_1^2}$ is not applicable in this case. In the present discussion a more careful application of the Prandtl-Glauert method to three-dimensional flow gives the following results:

The Prandtl-Glauert method does not lead to a universal velocity or pressure correction formula that is independent of the shape of the body. The factor $1/\sqrt{1-M_1^2}$ is applicable only to the case of two-dimensional flow. The increase with Mach Number of the pressures over a slender body of revolution is much less rapid than for a two-dimensional airfoil. An approximate formula from which the increase can be estimated is derived theoretically. The increase with Mach Number of the maximum axial interference velocity on a slender body of revolution in a closed wind tunnel is given approximately by the factor $1/(1-M_1^2)^{3/2}$, rather than by the factor $1/(1-M_1^2)^2$ previously obtained by Goldstein and Young and by Tsien and Lees.

Investigation of the Stability of the Laminar Boundary Layer in a Compressible Fluid. Lester Lees and Chia-Chiao Lin. *U.S., N.A.C.A., Technical Note No. 1115*, September, 1946. 86 pp., figs. 15 references.

The stability of two-dimensional laminar flows of a gas is investigated by the method of small perturbations. The chief emphasis is placed on the case of the laminar boundary layer.

Part I of the report deals with the general mathematical theory. The general equations governing one normal mode of the small velocity and temperature disturbances are derived and studied in great detail. For Reynolds Numbers of the order of those encountered in most aerodynamic problems, the temperature disturbances have only a negligible effect on those particular velocity solutions which depend primarily on the viscosity coefficient ("viscous solutions"). Indeed, the latter are actually of the same form in the compressible fluid as in the incompressible fluid, at least to the first approximation. Because of this fact, the mathematical analysis is greatly simplified. The final equation determining the characteristic values of the stability problem depends on the "inviscid solutions" and the function of Tietjens in a manner similar to the case of the incompressible fluid. The second viscosity coefficient and the coefficient of heat conductivity do not enter the problem; only the ordinary coefficient of viscosity near the solid surface is involved.

Part II deals with the limiting case of infinite Reynolds Numbers. The study of energy relations is emphasized. It is shown that the disturbance will gain energy from the main flow if the gradient of the product of mean density and mean vorticity near the solid surface has a sign opposite to that near the outer edge of the boundary layer. A general stability criterion has been obtained in terms of the gradient of the product of density and vorticity, analogous to the Rayleigh-Tollmien criterion for the case of an incompressible fluid. If this gradient vanishes for some value of the velocity ratio of the main flow exceeding $1-1/M$ (where M is the free stream Mach Number), then neutral and self-excited "subsonic" disturbances exist in the inviscid fluid. (The subsonic disturbances die out rapidly with distance from the solid surface.) The conditions for the existence of other types of disturbance have not yet been established to this extent of exactness. A formula has been worked out to give the amplitude ratio of incoming and reflected sound waves.

When the solid boundary is heated, the boundary layer flow is destabilized through the change in the distribution of the product of density and vorticity, but is stabilized through the increase of kinematic viscosity near the solid boundary. When the solid boundary is cooled, the situation is just the reverse. The actual extent to which these two effects counteract each other can only be settled by actual computation or some approximate estimates

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of the minimum critical Reynolds Number. This question will be investigated in a subsequent report.

Part III deals with the stability of laminar flows in a perfect gas, with the effect of viscosity included. The method for the numerical computation of the stability limit is outlined; detailed numerical calculations will be carried out in a subsequent report.

Some Mathematical Aspects of Compressible Flow. R. H. Dalitz. *Australia, Council for Aeronautics, Report ACA-20,* January, 1946. 39 pp., figs. 63 references.

The study of fluid flow phenomena at high speeds requires consideration of the compressibility and, consequently, of the thermodynamics of the fluid. For a real fluid, this would be a complicated problem and in fact is not well understood, so that in this review the theory is developed for a perfect gas with small viscosity and heat conductivity, which is a satisfactory approximation under most circumstances. The discussion is confined mainly to flow in two dimensions. The features of the flow are emphasized by means of special examples, and the limit line, at which the acceleration becomes infinite and the theoretic flow field double-valued, is studied

The most outstanding feature of high-speed flow—the shock wave, is treated on the continuum theory, which cannot be entirely adequate but which gives some understanding of the nature of the shock wave. For a fluid of vanishingly small viscosity and heat conductivity, the shock wave may be idealized to a discontinuity in the flow field, across which the vorticity of the flow may change abruptly. A brief discussion is given of the physical interpretation of the limit line and of the criterion for the breakdown of irrotational flow. The line of thought followed in the recent methods for solution of two-dimensional compressibility problems is outlined in an appendix, where the methods adopted for the approximate solution of such problems also are discussed. The report is intended to supply the mathematical background to present-day compressible flow theory and to indicate the problems that still lie before it.

Rotation par Chute Libre des Ailettes Rectangulaires de Form Allongée (Rotation of Elongated Rectangular Airfoils in a Free Fall). Paul Dupleich. *France, Secrétariat d'État à l'Aviation, Publications Scientifiques et Techniques No. 176,* 1941. 75 pp., illus. 5 references.

Flat sheets of paper or metal, varying in size from 4 by 1.5 cm. to 60 by 32 cm. and with a loading per unit area of 0.14–21.6 Gm./dm.^{2}, were photographed in free falls in air from various heights, to establish a mathematical theory of their motion. The falls of isosceles trapezoids, cylindric airfoils, and 3- or 4-bladed rotors forming vanes or prisms, the rotation of graphite grains in vertical currents, and falls in water were also observed. The fall of a rectangular airfoil in any fluid of low viscosity should lead to flow patterns which are, for each fluid, determined exactly by the loading per unit area, the width, and the aspect ratio.

High-Speed Investigation of Skin Wrinkles on Two NACA Airfoils. Harold L. Robinson. *U.S., N.A.C.A., Technical Note No. 1121,* August, 1946. 48 pp., figs. 4 references.

The effects on the aerodynamic characteristics of skin wrinkles on the forward part of the upper surface of two N.A.C.A. airfoils are investigated and the results are compared with those obtained for the same two airfoils in a smooth condition. The airfoils used were the NACA 66, 1–115, and 23015 sections. The wind-tunnel investigation included speeds up to a Mach Number of 0.73. The results showed that no appreciable change in normal-force or pitching-moment characteristics over the range of Mach Number tested (0.25 to 0.73) was caused by the wrinkle on an airfoil section. The drag for the wrinkled configurations was greater than that for the smooth configurations. The wrinkles caused a reduction in the critical speed and a corresponding reduction in the speed at which drag force breaks occur. The wake at subcritical speeds spread an insignificant amount, and the "shock spread" of the wake (the spread of the wake due to shock on the airfoil) occurred at lower Mach Numbers for the wrinkled configurations than for the smooth configurations. The results further indicated that the span of the wrinkles tested had no effect on the section aerodynamic characteristics. A theoretic calculation of the pressure distribution over the wrinkles was made and compared with a low-speed pressure measurement.

Standard Nomenclature for Airspeeds with Tables and Charts for Use in Calculation of Airspeed. William S. Aiken, Jr. *U.S., N.A.C.A., Technical Note No. 1120,* September, 1946. 37 pp., figs. 8 references.

Symbols and definitions of various air-speed terms that have been adopted as standard by the N.A.C.A. Subcommittee on Aircraft Structural Design are presented. The equations, charts, and tables required in the evaluation of true air speed, calibrated air speed, equivalent air speed, impact and dynamic pressures, and Mach and Reynolds Numbers are compiled. Tables of the standard atmosphere to an altitude of 65,000 ft. and a tentative extension to an altitude of 100,000 ft. are given along with the basic equations and constants on which both the standard atmosphere and the tentative extension are based.

Effect of Compressibility at High Subsonic Velocities on the Lifting Force Acting on an Elliptic Cylinder. Carl Kaplan. *U.S., N.A.C.A., Technical Note No. 1118,* July, 1946. 30 pp., figs. 28 references.

An extended form of the Ackeret iteration method, applicable to arbitrary profiles, is utilized to calculate the compressible flow at high subsonic velocities past an elliptic cylinder. The angle of attack to the direction of the undisturbed stream is small and the circulation is fixed by the Kutta condition at the trailing end of the major axis. The expression for the lifting force on the elliptic cylinder is derived and shows a first-step improvement of the Prandtl-Glauert rule. It is further shown that the expression for the lifting force, although derived specifically for an elliptic cylinder, may be extended to arbitrary symmetric profiles.

High-Speed Airflow. I, II. R. Smelt. *Flight,* Vol. 50, Nos. 1973, 1974, October 18, 24, 1946; pp. 417–419; pp. 443–446, illus. An address reviewing the methods, equipment, and results of German research.

Investigations on Bellows Flaps. F. W. David and I. H. Ring. *Australia, Council for Aeronautics, Report ACA-21,* February, 1946. 18 pp., illus. 8 references.

The problem of fitting Youngman aerodynamically operated bellows flaps as air brakes on a particular high-speed aircraft was investigated and the requirements necessary for the satisfactory operation of the flaps were laid down. A series of tests was made to determine the optimum arrangement of the flap system, and the pressure distribution inside and outside a flap model is shown. The wake effect on the tailplane was obtained. An approximate method of calculating the time of operation of a bellows flap was developed. Conclusions are incomplete because of the decision, due to a change of policy, not to fit air brakes to the considered aircraft. Optimum flap angles to answer the requirements have not been determined, but an efficient arrangement, with negligible drag in normal flight, has been designed.

The Prevention of Flutter of Spring Tabs. A. R. Collar. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2034,* May, 1943. 12 pp., figs. 7 references. British Information Services, New York. $0.75.

The report gives a correlation of the results of earlier researches into the prevention of flutter of spring tabs. The restrictions on the way in which tab mass balance must be applied, which are given in the earlier work, are shown to be simply derivable from the conditions necessary for the elimination of elastic and inertia couplings; and from these considerations an optimum length of tab-balancing arm is deduced. The recommendations for avoidance of spring-tab flutter are summarized. Two appendixes deal respectively with the optimum length of arm when the aerodynamic actions are taken into account, and the relation between the results of the earlier work and the recommendations of the present report.

Air Transport—General

Surface-Carrier Airline Operation. John A. Eubank. *Aero Digest,* Vol. 53, No. 5, November, 1946, pp. 48, 153.

H.R. 5687, pending in Congress, proposes to amend the Merchant Marine Act of 1936 by permitting marine shipping companies to engage in overseas and foreign air transportation. It is held that healthy competition by surface carriers should be encouraged, since it would not be unduly harmful to the air lines and would be beneficial to the nation's commerce in general.

Australia Spreads Her Wings; Developments in Civil Aviation. L. Spence. *Indian Aviation,* Vol. 30, No. 7, July, 1946, pp. 160, 162, 163.

International Air Transport. Sir William P. Hildred. *Indian Aviation,* Vol. 30, No. 9, September, 1946, pp. 198, 200, 202. (Reprinted from *World Review.*) The organization of the International Air Transport Association.

Airplane Descriptions

Bell XS-1, A.A.F. Supersonic Research Plane. *Army Air Forces, Office of Public Relations, Release,* November 20, 1946. 2 pp.

Designed to fly at a top speed of 1,700 m.p.h. at an altitude of 80,000 ft., the Bell XS-1 is the product of a cooperative program of the Army Air Forces, Bell Aircraft Corporation, and the National Advisory Committee for Aeronautics. Its sole function will be the recording of data on the effect of transonic and supersonic speeds on an aircraft. Described in simplest terms, the XS-1 is a rugged air frame driven by a powerful rocket engine. Since it is not a combat plane, it has no armament or armor protection for the pilot. It employs a rather conventional configuration. The use of the swept-back wing has been avoided. The wing is extremely thin, with a maximum thickness of only ten per cent of the chord. After initial test work has been completed, it is planned to try other wing designs incorporating the knowledge gained by experience with the test model.

Power for the XS-1 is supplied by an engine designed and manufactured by Reaction Motors, Inc. This consists of four units, burning alcohol and liquid oxygen, each of which produces a static thrust of 1,500 lbs., or a total thrust output for the plane of 6,000 lbs. Power output is controlled by selection of the number of cylinders to be fired at one time. Thus the pilot can use 1,500, 3,000, 4,500, or the full 6,000-lbs. thrust at his discretion. In the present design, a pressurized system is employed, with gaseous nitrogen used to force the liquid oxygen and alcohol into the burners. As a consequence, the craft fitted with the pressurized system can operate for only 2.5 min. at full 6,000-lbs. thrust, compared to 4.2 min. when equipped with a projected turbopump system. Top speed for the existing power unit is estimated at 1,000 m.p.h. at 60,000 ft., instead of the 1,700 m.p.h. velocity at 80,000 ft. for which the plane was designed. The rate of climb of 28,000 ft. per min. with the present engine compares with 45,000 ft. per min. planned for the turbo unit.

Length of the airplane is 31 ft.; it measures 10 ft. 10 in. from ground to tailtop; wing span is 28 ft. The wing area is 130 sq.ft. The unloaded weight of the plane, equipped with the turbine pump version, is 4,892 lbs., of which 526 lbs. is test equipment. The rocket fuel weighs more than one and one-half times the weight of the empty plane—8,177 lbs. The overall weight of a fully loaded craft will be 13,069 lbs. Range will be a little more than 100 miles.

Bell Aircraft's contract calls for demonstration of the following minimum performance requirements: an 8*g* pull-out, at an indicated air speed not exceeding 500 m.p.h.; an 8*g* pull-out at minimum speed; proof of the specified endurance at rated thrust; and take-off and climb to 35,000 ft. under its own power. Finally, it must respond satisfactorily to controls at a speed of Mach Number 0.8. The wings have an aluminum-alloy skin machined from solid stock, so as to permit a thickness at the butt of more than $1/2$ in. while it tapers off to only slightly more than $1/8$ in. at the tips. Overall, the plane is designed to stand a force of 18*g*.

Unique Features Built Into XS-1. *Aviation News,* Vol. 6, No. 23, December 2, 1946, p. 12, illus. (Cf. preceding abstract.)

Chance Vought XF6U-1 Jet Propelled Fighter. *United Aircraft Corp., Chance Vought Aircraft Div., Release,* Recd. November 29, 1946. 3 pp.

The small size, light weight, sleek finish, and simple design that characterize the Chance Vought XF6U-1 Navy jet fighter have been realized primarily through the use of Metalite, a structural material consisting of two thin sheets of high-strength aluminum alloy bonded to a balsa-wood core. The new material has been utilized in the construction of the wings, fuselage, and tail surfaces. It is intended to eliminate skin wrinkling and to make possible a saving in weight, since fewer internal reinforcing members, such as stiffeners, ribs, and bulkheads, are necessary. In addition, the material affords reduction in drag because sections can be molded as single units, thereby reducing the number of external joints.

Described by the Navy as in the "well over 500-m.p.h. class," the XF6U-1 is the first jet-propelled airplane built by Chance Vought Aircraft. It is 11 ft. 9 in. high, 32 ft. 10 in. long, has a wing span of 30 ft. 2 in., a tricycle landing gear and droppable wing-tip fuel tanks. It is built for either carrier or land operations, taking off from a carrier flight deck with the aid of a catapult and from a landing field with normal jet power. The Westinghouse jet unit, of a new design, is installed in the lower aft portion of the fuselage, the exhaust being ejected from the centerline of the airplane below the tail cone. Air-intake scoops are built into the leading edge of the wing on either side of the fuselage.

North American XFJ-1 Jet Propelled Shipboard Fighter. *North American Aviation, Inc., Release,* November 27, 1946. 2 pp.

The new XFJ-1 represents North American's initial entry into the field of jet-propelled military aircraft. Powered by a General Electric jet engine of new design, it is built for carrier and land operations, taking off from a carrier flight deck with the aid of a catapult and from a landing field with normal jet power. The single-engine, single-seat, low-wing monoplane with short stubby wings is reported to be the first American jet fighter to employ a single straight ram duct with its entrance in the nose of the airplane. The air intake, engine, and fuel tanks are enclosed within the airplane, which has thin, high-speed, laminar-flow wings. Another characteristic of the XFJ-1 is the high vertical stabilizer with 10° dihedral, which places the tail assembly up out of the wing shock wave area at high speeds. The airplane has tricycle landing gear and droppable wing-tip tanks. The height of the XFJ-1 is 14 ft. 6 in.; wing span, 38 ft. 1 in.; length, 33 ft. 7 in.

Navy Reveals Two New Jet Fighters. *Aviation News,* Vol. 6, No. 22, November 25, 1946, p. 9, illus. The Chance Vought XF6U-1 and the North American XFJ-1. (Cf. two preceding abstracts.)

Consolidated Vultee B-36. *Consolidated Vultee Aircraft Corp., Release,* Recd. November 8, 1946. 6 pp.

The Army Air Forces released additional details concerning the B-36, including for the first time a bomb-load comparison with the B-29. At reduced range, the B-36 can carry 36 tons of bombs, more than three times as many as the B-29 can carry for the same distance. The plane is 163 ft. long, 47 ft. high, has a wing span of 230 ft., and a maximum speed of over 300 m.p.h. The wing tanks hold 21,116 gal. of gasoline and 1,200 gal. of oil. The 4-section bomb bay has a volume of 12,300 cu.ft.

The wing, with an area of 4,772 sq.ft., incorporates an N.A.C.A. laminar-flow airfoil and is mounted slightly forward of the midpoint of the fuselage. The horizontal tail surfaces cover an area of 978 sq.ft.; the vertical tail surfaces, 542 sq.ft.; and the six flaps, 519 sq.ft. Total area of the fuselage skin is 5,635 sq.ft. The bomber has a volume of 17,724 cu.ft. The pressurized forward and aft cabin space totals 3,924 cu.ft. Extending the length of the entire bomb-bay section, on the left side of the fuselage below the wing, is a pressurized magnesium communications tunnel 85 ft. long and 2 ft. in diameter. This tunnel connects the forward and aft cabins and is provided with a 4-wheel scooter by which crew members travel from cabin to cabin. Nearly $27\frac{1}{2}$ miles of wiring are required in the electrical system. Largest of the plane's 300 electric motors is the 16-hp. motor that drives the hydraulic system pump. Smallest is a $1/50$-hp. motor that opens and closes the carburetor air-filter door.

The craft is powered by six Pratt & Whitney 28-cylinder, pusher-type engines developing a total of 18,000 hp., which are mounted on the trailing edge of the wing. Each engine turns a 19-ft. Curtiss electric reversible-pitch, hollow steel-bladed propeller, provided with thermal anti-icing equipment. The B-36 is also provided with wing and tail anti-icing and blister defrosting of the heated-surface type. The use of two superchargers on each engine, together with pressurized cabins, enables the B-36 to attain a ceiling of 40,000 ft. The fundamental factor that influenced the selection of the pusher-type engine and nacelle was the desire to preserve a smooth airflow over the wing. Nacelle location in the aft portion of the wing also reduces the external nacelle drag, with a corresponding increase in range using the same fuel and weight. Directional stability of the plane likewise is improved by use of pusher-type nacelles. Each engine weighs about 3,500 lbs. and each complete power-plant installation weighs approximately 6,500 lbs.

A new type of landing gear will be used on production models. Eight 56-in. wheels will be placed on the main landing gear instead of the two 110-in. wheels as on the experimental bomber now undergoing flight tests. The eight comparatively small wheels, arranged in 4-wheel trucks, will distribute the bomber's total weight of 278,000 lbs. over a much greater area than the two single wheels.

The First Jet Flying-Boat Fighter. *The Aeroplane,* Vol. 71, No. 1850, November 8, 1946, p. 531, illus.

The Saunders-Roe SR/A1, powered by two Metro Vickers F2/4 axial-flow jet engines, is a single-place aircraft with a pressure

cabin, semiretractable wing floats, and pilot-ejection equipment. A Saunders-Roe mooring hook enables the pilot to pick up moorings without leaving the cockpit. It is stated that all fighter requirements are met and that the necessity of providing water clearance for propellers is eliminated.

The Saro SR/A1. *Flight*, Vol. 50, No. 1976, November 7, 1946, p. 497, illus. (Cf. preceding abstract.)

Curtiss-Wright CW-32 Cargo Transport. *Curtiss-Wright Corp., Release*, November 19, 1946. 3 pp.

The four-engined cargo airplane designated the CW-32 is capable of carrying 25,000 lbs. a distance of 1,500 miles, or 20,000 lbs. for 2,500 miles without refueling. It weighs 80,000 lbs. when fully loaded and has a maximum cruising speed of 270 m.p.h. at 25,000 ft. It is reported that the airplane will operate at a direct cost of less than five cents per ton-mile. It has a total cargo volume of 4,000 cu.ft. in a compartment 59 ft. long, 9 ft. wide, and from 7 to 9 ft. high. An optional tail-opening arrangement, whereby the entire aft end of the fuselage may be raised, will permit full cross-section end loading of large articles, such as automobiles, motor trucks, industrial machinery, and other items too bulky to be loaded through the side entrances. Automatic temperature control through use of both heating and refrigerating equipment will permit carrying of all types of perishables and other items requiring constant temperature. The pilot's cabin is to be pressurized and special attention is given to crew comfort and convenience for long flights. Power for the CW-32 is to be supplied by four R-1820 Wright Cyclone engines with exhaust-driven turbosuperchargers. It is to be equipped with Curtiss electric reversible propellers with automatic propeller synchronizers as standard equipment.

Northrop Tri-Motor "Pioneer." *Aero Digest*, Vol. 53, No. 4, November, 1946, p. 81, illus. (Cf. AER 11/46:31.)

Northrop Pioneer is Trimotor Workhorse. *Aviation*, Vol. 45, No. 11, November, 1946, p. 67, illus. (Cf. AER 11/46:31.)

The Aeroplane Aircraft Industry Review. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, pp. 573–587, illus. Illustrations, three-view drawings, and brief specifications of 52 current and projected British aircraft.

Today's British Transports. *Flight*, Vol. 50, No. 1977, November 14, 1946, pp. 532–537, illus. Includes a table of specifications.

Avro XIX. Roy Cross. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, pp. 5–7, illus.

The Avro XIX service-type aircraft was converted to commercial use and changes were made in the cabin-lighting equipment, baggage space, and pilot's compartment. Important specifications are listed.

Tricycle Undercarriage for Hermes IV. *Handley Page Bulletin*, Vol. 12, No. 140, October, 1946, pp. 2, 3, illus. A brief review of the specifications, with particular attention given to the landing gear.

Flying Boats for Empire Routes; B.O.A.C. Conversion of Sunderland III. *Modern Transport*, Vol. 56, No. 1443, November 9, 1946, pp. 7, 24, illus.

A New Four Motor Transport. *The Aeroplane*, Vol. 71, No. 1847, October 18, 1946, p. 435, illus.

A brief description of the new (British) General Aircraft Universal Transport, high-wing cantilever monoplane, which provides seats for 60 passengers and a freight compartment. Power is supplied by four Bristol Hercules 260 engines driving four-bladed, constant-speed, feathering and braking propellers, each 14 ft. in diameter.

Swedish Concern Unveils Postwar Civil Planes (Saab 90 and 91). *Aviation*, Vol. 45, No. 11, November, 1946, pp. 70, 71, diagrs. (Cf. AER 11/46:32.)

British Military Aircraft. *Flight*, Vol. 50, No. 1977, November 14, 1946, pp. 523–531, illus. Design and performance characteristics are briefly discussed and tabulated.

Tropical Tests of Fairey "Firefly" MK. IV. Aircraft. *Engineering*, Vol. 162, No. 4217, November 8, 1946, p. 436. (Cf. AER 11/46:31.)

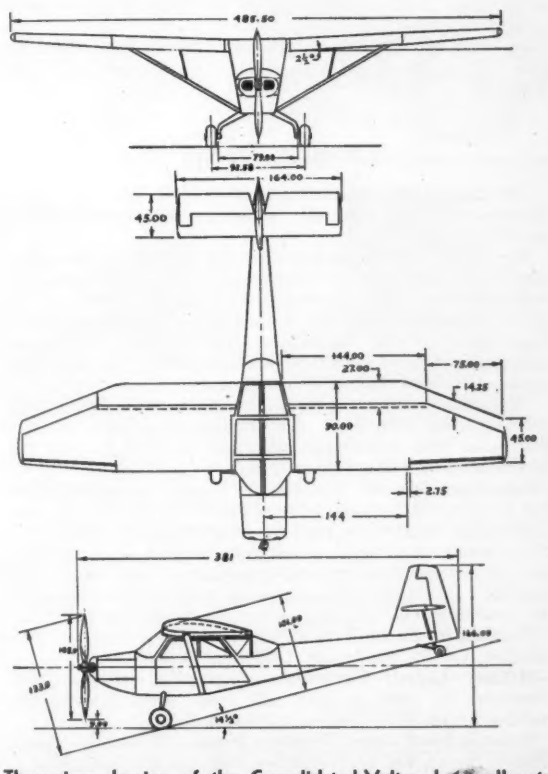
Consolidated Vultee All-Metal Liaison Plane. *Consolidated Vultee Aircraft Corp., Release*, Recd. November 15, 1946. 6 pp.

Built for a variety of jobs, the Consolidated Vultee L-13 will be adaptable for observation, communication, and photographic service. Its cabin can be converted into an ambulance, with space for two litter patients, an attendant, and a pilot. Wire laying, courier service, artillery spotting, supply dropping, aerial pickup, and light cargo transportation are other jobs the plane can handle. Skiis can be installed in place of wheels or the landing gear can be replaced by floats. Length of the plane is 31 ft. 9 in.; wing span, 40 ft. 5.5 in.; and height, 8 ft. 5 in. Gross weight is 2,900 lbs. and useful load is 1,012 lbs.

Several features distinguish the L-13 from previous types of liaison planes. Wing panels can be folded back to facilitate rapid ground movement. Without having its propeller removed, it can also be towed by another plane, glider fashion, up to speeds of 150 m.p.h., and then released in flight to proceed under its own power. The wing is a two-spar type of all-metal riveted construction and is covered with aluminum-alloy sheet. A leading-edge subassembly is attached to the front spar. The folding operation is accomplished by removing the front spar-attaching bolts, permitting the wing panels to rotate, with the leading edge down, about a line through the rear spar-attaching fitting and the wing lift-strut fitting. Each wing panel is equipped with a large trailing-edge flap of the slotted type. The flap, which has an area of 25 sq.ft., extends from the inboard end of the aileron to the fuselage. Each flap is 11 ft. in length, with a chord of 27 in., and extends 45° down.

With flaps extended and with full power, the L-13 can take off in only 230 ft., and can land in only 227 ft. at 43.5 m.p.h. In order to clear a 50-ft. obstacle, the take-off distance is 470 ft. and landing distance 482 ft. The elevator has an angular movement of 25° up and 20° down. A feature of the stabilizer is its location in a higher plane than on conventional light aircraft. Its position through the mid-section of the fin facilitates folding of the wings and protects the assembly from damage during towing operations. Double-slotted ailerons with a fixed auxiliary airfoil are incorporated in the wing. These consist of a single spar with diagonal torque ribs and are fabric covered. The fuselage consists of two sections fastened together by bolts.

The L-13 is equipped with a 245-hp. Franklin 0-425-5 engine, with a two-blade, controllable-pitch propeller, electrically operated. With that power plant the plane has a maximum speed of 115 m.p.h., cruises at 92 m.p.h. and, with a 46-gal. fuel tank, has a range of 368 miles. By adding an auxiliary tank, a pilot can increase the range to 750 miles. Service ceiling is 15,000 ft.



Three-view drawing of the Consolidated-Vultee L-13 all-metal liaison plane.

Convair Model L-13 Has Folding Wings. *Aviation News*, Vol. 6, No. 23, December 2, 1946, p. 25. (Cf. preceding abstract.)

Away with Crew Room Blues. A. F. Hailey. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, pp. 8, 9, illus. (Cf. AER 7/46:37.) The Percival Prentice elementary trainer.

Fokker Producing Personal Four-Placer (F.25 Promotor). *Aviation*, Vol. 45, No. 11, November, 1946, p. 72, diagr. (Cf. AER 12/46:45.)

Nord 1200 Norecrin. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, p. 31, illus. Brief information about the military liaison and civilian versions.

The S.N.C.A. du Centre NC-840. *The Aeroplane Spotter*, Vol. 7, No. 175, November 16, 1946, p. 272, illus. A brief description of the French NC-840 personal airplane built by the Société Nationale de Constructions Aéronautiques du Centre.

Higher Performance Is Quoted for Chum. *Aviation News*, Vol. 6, No. 22, November 25, 1946, p. 14, illus. Revised performance figures for the Aeronca Chum personal plane.

The Bonanza. Leighton Collins. *Air Facts*, Vol. 9, No. 11, November, 1946, pp. 20–38, illus. A pilot's report on the flying characteristics of the Beechcraft Bonanza, with a tabulation of the costs in business or pleasure operation.

The Fairchild F-11 Husky. *The Aeroplane Spotter*, Vol. 7, No. 174, November 2, 1946, pp. 261, 262, illus.

Mallard Amphibian Presented by Grumman. *Aviation*, Vol. 45, No. 11, November, 1946, p. 66, illus. (Cf. AER 12/46:45.)

Stinson Reveals 1947 (150) Voyager; Latest Version of Four-Placer Is Deluxe Combination Personal Plane or Light Cargo Hauler. *Aviation*, Vol. 45, No. 11, November, 1946, p. 68, illus.

Dallas Firm Grooms Four-Seater (Weatherly-Campbell Colt). *Aviation*, Vol. 45, No. 11, November, 1946, p. 69, illus. (See AER 11/46:32.)

The Smaller Civil Types. *Flight*, Vol. 50, No. 1977, November 14, 1946, pp. 538–540, illus.

Handling Notes. D. A. S. McKay. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 90–92, 95, 96, diagrs.

The performance qualities and general characteristics are summarized for four British light airplanes: the Auster Autocrat, Miles Magister, de Havilland Tiger Moth, and Percival Proctor V.

Miles Gemini. *Aeronautics*, Vol. 15, No. 4, November, 1946, p. 75, illus. Some specifications of the Miles M65 four-seater cabin monoplane.

De Havilland Chipmunk. William Green. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, p. 12, illus. (Cf. AER 9/46:40.)

Airplane Design

The Case for the Tailless Aircraft. G. H. Lee. *The Royal Aeronautical Society, Journal*, Vol. 50, No. 431, November, 1946, pp. 872–887, figs.

The writer presents the case that can be made for the tailless aircraft on the grounds of improved performance and operational suitability, and states his conclusions regarding the best layouts for the long-range and short-range types. Performance advantages claimed for the Rider-Plane version, all-wing version, and high-speed jet-propelled aircraft are set forth. The main operational advantages claimed are enumerated.

"Spearhead" Airliner. *Flight*, Vol. 50, No. 1976, November 7, 1946, pp. 498a, 498b, illus. A conception of tailless air liners of the future with swept-back wings and powered by four gas-turbine units operating pusher propellers.

Supersonic Speeds? Franklin D. Walker. *Army Ordnance*, Vol. 31, No. 159, November-December, 1946, pp. 238, 239, illus.

Problems involved in reaching aircraft speeds greater than that of sound are outlined. Some characteristics of the Bell XS-1 aircraft, developed for supersonic speed tests, may further their solution. Comments are made about ram-jet experiments and the possibility of using atomic energy as a source of power.

The Case for the All-Wing Principle. A. James Payne. *Indian Aviation*, Vol. 30, No. 7, July, 1946, pp. 164–166.

Military Aircraft Tomorrow. *Flight*, Vol. 50, No. 1977, November 14, 1946, pp. 518, 519, illus. Some comments on possible British developments in the near future.

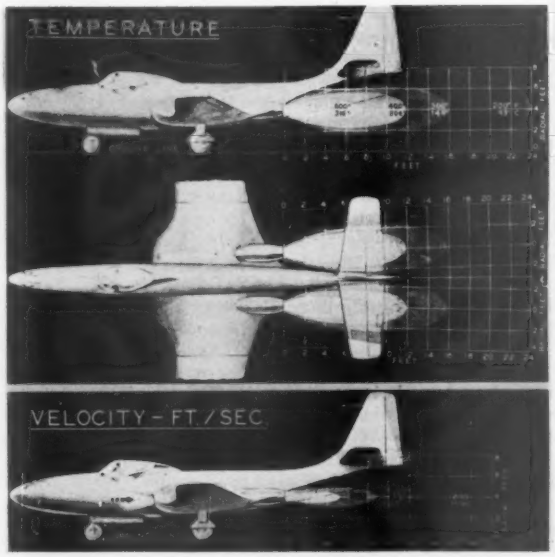
Notes on Small Aircraft Fuselage Design. Richard G. Naugle. *Western Flying*, Vol. 11, November, 1946, pp. 22, 23, 54, illus.

In designing a low-drag fuselage, arbitrarily assuming that the angle of incidence can be equal to the angle of attack at cruising speed and measuring it from the thrust line, normal seat inclination, or an arbitrary fuselage reference line, can lead to fuselage attitudes causing considerably more than the minimum calculated drag. The angle of incidence and attitude of the fuselage should preferably be such that the minimum fuselage drag will occur at or below cruising speed. The effects of canopy design and rear fuselage shape on drag are considered.

Cabin Pressurization Units. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 75–77, 167, illus. Details of the construction and operation of the AiResearch cabin supercharger and its components.

Design Development of the McDonnell FD-1 Phantom. Kendell Perkins. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 40–48, illus.

Particulars are given about the development of the Navy's first all-jet aircraft. Design policies decided on at an early stage in development of the FD-1 Phantom were: first, that it was to be designed on a conservative basis, except for the engines and special features dictated by their use; second, that, when a close decision arose between a design that was simple to build, operate, and maintain and one that was more complicated although somewhat more efficient on paper, the simple one would generally be chosen. The military requirements for the aircraft are outlined.



McDonnell FD-1 Phantom jet temperatures and velocities. (See "Design Developments of the McDonnell FD-1 Phantom.")

The De Havilland Dove and S.N.C.A.S.O. SO-94. James Hay Stevens. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, pp. 10, 11, illus.

The characteristics of the SO-94 feeder-line aircraft, the construction of which was begun during the German occupation by the Société Nationale de Constructions Aéronautiques du Sud-Ouest, are compared with those of the de Havilland Dove.

Short Sturgeon. *Flight*, Vol. 50, No. 1973, October 17, 1946, pp. 422–426, illus.

The design, structure, and performance of a new British carrier-based aircraft are reviewed. To make it possible to fold a 60-ft. wing down to 20 ft., an oblique hinge-type fold is used. Other features incorporated to make the aircraft suitable for operation from carriers include the provision of a good field of view forward and downward from the pilot's seat, accelerator and arresting equipment, and provision for rocket-assisted take-off. A unidirectional initial shock absorption characteristic built into the main landing-gear legs enables "drop" landings to be made without damage.

The Navy's Latest. *The Aeroplane*, Vol. 71, No. 1847, October 18, 1946, pp. 443–448, illus. (Cf. preceding abstract.)

Control of Pressure. M. Fermoy. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 136, 139, 140, diagrs.

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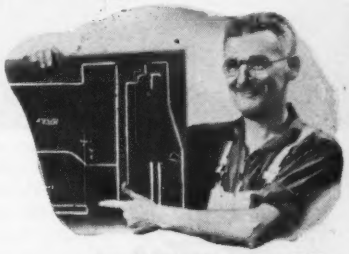

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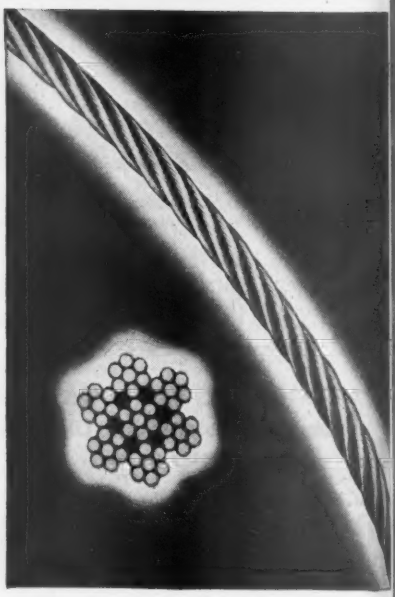

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A CENTURY OF CONFIDENCE

The features of the cabin air-pressurization system being used for the majority of British aircraft designs are described.

Cargo Release Mechanisms. I. W. L. Spielman and A. D. Neal. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 82, 83, 121, diagrs.

Large articles of cargo must often be carried outside the aircraft structure, particularly in emergency shipments. Devices for attaching the cargo to the aircraft and releasing it during flight range from simple supports, joined by pins that can be withdrawn by pneumatic or hydraulic pressure, to complex mechanisms actuated by explosive cartridges or electrical blasting caps. The various types are evaluated and compared.

Airports and Airfields

Low-Cost Lighting System for Airports. *D. W. Onan & Sons Inc., Release No. 159*, Recd. December 4, 1946. 7 pp., illus.

The Onan 3CK airport floodlighter is a self-contained unit. A 3,000-watt, 115-volt, a.c. electric generating plant and three 1,000-watt floodlights, plus an obstruction light, are complete in one assembly, mounted on a two-wheel, rubber-tired trailer. A type CK air-cooled gasoline engine is the prime mover for the generating plant. The 12-volt d.c. power supply may be utilized in emergency as a booster for small aircraft. Four receptacles on the control panel provide 115-volt, a.c. power for electric drills, metal cutters, and similar tools used for on-the-field repair work.

Flying-Boat Mooring Buoy; Saunders-Roe Development. *Modern Transport*, Vol. 56, No. 1444, November 16, 1946, p. 5, diagr. It is intended for use with an automatic pickup hook located on the keel of the flying boat.

Avigation

Pressure Pattern Navigation; Isobar Flying, The Modern Trend. Jennings B. Beran. *The Log of Navigation and Aviation*, Vol. 4, No. 7, November, 1946, pp. 10–13.

How Blows the Wind? Robert N. Buck. *Air Facts*, Vol. 9, No. 12, December, 1946, pp. 18–24, diagr. A simplified explanation of pressure-pattern navigation.

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Biography

Britain's Test Pilots. XV—Sydney Albert Thorn, Chief Test Pilot, A. V. Roe & Co., Ltd. John Yoxall. *Flight*, Vol. 50, No. 1976, November 7, 1946, pp. 500–502, illus.

Business and Finance

These Are the Export Markets. Raymond L. Hoadley. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 82, 83, illus.

A survey of the foreign-trade prospects for the sale of U.S. airplanes, engines, and accessories outlines the market in Latin America, and indicates that longer-term prospects for American aeronautical exports are to be found in Europe and the Far East. Competition is to be expected from British aircraft constructors who are planning to develop the Latin-American market.

The Stinson Distribution Plan. Franklin M. Reck. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 43–45, 162, illus.

The Stinson Division of Consolidated Vultee Aircraft Corporation adopted a sales and service plan whereby approved dealers must have met certain qualifications. Cooperation is extended to them in improving facilities, estimating sales, cultivating individual and fleet-sales prospects, and rendering service to the buyer. The factory sales organization and its work are described.

The Personal Airplane, Its Market, Design and Utility. I. Peter Altman. *Automotive and Aviation Industries*, Vol. 95, No. 10, November 15, 1946, pp. 22–31, figs., tables.

A market survey based on an analysis of statistical data released by Government agencies, design data released by manufacturers, and interviews with owners, operators, and manufacturers of personal airplanes.

Air Industrial Planning in the Postwar Period. B. W. Childlaw and E. W. Rawlings. *Mechanical Engineering*, Vol. 68, No. 11, November, 1946, pp. 971–975, illus.

The highlights of a comprehensive report covering the industrial aspects of the postwar air program, which was submitted in October, 1945, to the Senate Military Affairs Committee, are discussed. After a brief statistical sketch of aircraft production in World War II, various phases of industrial planning for the future are considered: the research and development program, the importance of maintaining aircraft-industry organization, the reserve of production facilities and resources, joint preparedness plans of the Air Forces and the industry; coordination with other industries, airplane engine production, and the production history of the P-47.

Allis-Chalmers Annual Review 1945. *Allis-Chalmers Manufacturing Co.*, Catalog, 1946, 72 pp., illus.

Included in an extensively illustrated review of the activities and products of Allis-Chalmers Manufacturing Company in 1945 is a section outlining the company's contributions to aviation in that year and during the war. Among these were the manufacture for the Army and Navy of British de Havilland turbojet engines, the advancement of the company's own designs of gas turbines, the production of more than 100,000 turbosuperchargers for aircraft use, and a wide variety of electrical power and control equipment for aeronautical laboratories and wind tunnels. Extensive research work in gas turbines and stress analysis also was carried out.

British Suppliers of Aircraft Materials, Parts and Accessories. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, pp. 595–605, illus. About 350 companies are listed under 16 classifications. There is an alphabetical index to companies.

Control Systems

Thermal Expansion of Cables. H. C. Boynton and H. J. Godfrey. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 92, 95, 107, 108, 111, figs. 7 references.

The differences between the thermal expansion properties of steel control cables and the aluminum-alloy structure of the airplane, caused by the wide temperature changes involved in high-altitude flight, can be compensated for by using a control cable having a coefficient of expansion nearly equal to that of the aluminum alloys. Reference is made to a steel containing carbon, nickel, manganese, and chromium which has a coefficient of thermal expansion closely approaching that of aluminum alloys used in aircraft structures and meeting the other specifications for strength, elongation, ductility, and other properties. The fabrication of cables from that material is explained, as well as the tests to which it was submitted, the testing apparatus used, and the results obtained. Experiments to determine the thermal expansion properties of other alloys of steel and aluminum are described.

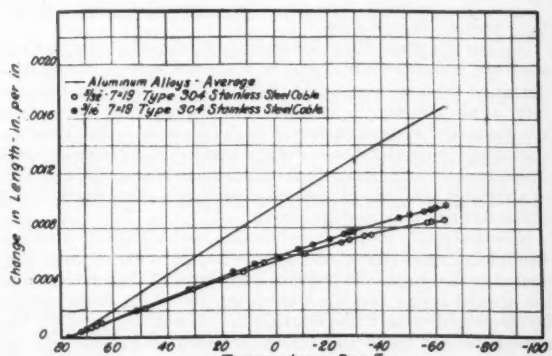


Illustration Courtesy John A. Roebling's Sons Company

Expansion properties of type 304 stainless-steel cables compared with the average expansion values of three aluminum alloys. (See "Thermal Expansion of Cables.")

The Mechanism of the Hydraulic Servo Control. H. G. Conway. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, pp. 569–572, diagrs.

Consideration is given to design problems and fundamentals of servomechanisms in which the movement of the pilot's control is exactly reproduced at the control surface involved; with a more or less fixed degree of forced multiplication. The main problems at present appear to be whether or not the controls should have "feel," that is, be reversible, and to design a method for overriding or disconnecting the controls upon failure of the hydraulic system. The problems of "feel" and emergency operation are not considered to have been solved satisfactorily by the existing systems described.

Education and Training

Preparing for an Airline Pilot Job. Charles A. Selby. *Air Facts*, Vol. 9, No. 11, November, 1946, pp. 39–42.

Electrical Equipment

Effects of Thermal Characteristics of Aircraft Generators on Load Analysis. Stanley Rogers. *Electrical Engineering*, Vol. 65, No. 12, December, 1946, *Transactions*, pp. 819–824, figs.

The elaborate electrical systems in modern long-range aircraft have made accuracy of generator-load analysis more important than ever before. A more precise evaluation of the adequacy of proposed generating equipment can be made by averaging expected loads over several different periods which are chosen on the basis of the generator's thermal characteristics. These averages are compared graphically with curves that show the maximum overloads generators can tolerate without damage. Methods of estimating the permissible overload curve are outlined.

A Special Generator for the "Flying Fortress." J. H. Walker and A. T. Stretton. *The Engineer*, Vol. 182, No. 4739, November 8, 1946, pp. 413, 414, illus.

An induction alternator for counterradar equipment was designed and manufactured together with the associated control gear by the British Thomson-Houston Company Ltd., Rugby, England.

Checking Electrical Assemblies. W. R. Mahoney. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 84, 168, illus.

Procedures for facilitating the assembly, inspection, and installation of electrical equipment are outlined. In the preparation of operation sheets for major assemblies and subassemblies of cables and wiring, demonstration boards were constructed on which were mounted samples of wiring and connections, detailing the proper assembly sequence and required quality standards. Photographs of the demonstration boards were incorporated in instruction manuals.

Engine Parts and Accessories

An Electron-Microscope Study of Used Nitrided-Steel Piston Rings. Thomas P. Clark and Walter A. Vierthaler. *U.S., N.A.C.A., Technical Note No. 1132*, September, 1946. 42 pp., figs., tables. 19 references.

Studies of surface films and coatings generated on piston rings, bearings, and other rubbing parts of aircraft engines during their operation are being conducted at the N.A.C.A. Cleveland laboratory in an attempt to identify their composition, their grain structure, and the mechanism of their formation. This information should aid in the choice of alloys best suited for rubbing parts. A determination of the method of formation is a preliminary step to a possible synthesis of pretreated surfaces having the desirable characteristics imparted by run-in.

A critical study of the altered surface layers found on nitrided-steel piston rings run in nitrided-steel cylinder barrels was conducted to determine the physical and chemical characteristics of the altered layers and the mechanism by which these coating layers were formed. The electron microscope was used for the examination of areas that heretofore could be studied only by electron and X-ray diffraction. The light microscope was used to study gross microstructures and oxidation-color patterns. The following information was obtained as a result of the investigation: (1) The running faces of nitrided-steel piston rings smeared during engine operation and a metallic layer that consisted of a virtually amorphous crust with an underlayer of finely fragmented crystals was deposited on the ring face. (2) The granular portion of the coating layer had chemical properties similar to those of an underlying nitrided steel but the vitreous top layer had a high resistance toward oxidation and corrosion. (3) The smooth portion of the coating was apparently formed by a melting and flowing of the surface as a result of friction-developed temperatures; the granular portion of the coating was apparently formed by a fragmentation and subsequent smearing of the strained surface crystals as a result of elevated temperatures and high surface pressures.

Standard Procedures for Rating and Testing Multistage Axial-Flow Compressors. *U.S., N.A.C.A., Technical Note No. 1133*, September, 1946. 57 pp., figs. 10 references.

The N.A.C.A. Subcommittee on Compressors appointed a group to establish a standard procedure for rating and testing multistage axial-flow compressors. In the past, axial-flow compressors have been rated and tested insofar as practical, in accordance with the standard procedures for rating and testing centrifugal compressors, but those procedures have often proved unsuitable for axial-flow types because of the fundamental differences in design and application. The group makes recommendations concerning the standardization of the test equipment, the instrumentation, the test procedure, the data to be taken, and the preparation of the data. The recommendations involve two types of equipment: (1) equipment using an external drive for the compressor, and (2) equipment in which the compressor is an integral part of a gas-turbine engine, jet propulsion engine, or a composite power plant. Derivations of important equations are set forth in an appendix. Air charts are obtained from "Gas Turbine Gas Charts" by A. Arorosi.

A New Variable Delivery Pump. *The Aeroplane*, Vol. 71, No. 1847, October 18, 1946, p. 454, illus.

A new Munro helical variable-delivery pump features an alternative arrangement of the twin meshing rotors. In one design the pitch of the thread increases progressively along the rotor, and in the other the rotor thread is of constant pitch with the depth of cut varying progressively from a minimum at the inlet end to a maximum at the outlet end. The metering sleeve permits infinite variation of the volume delivered.

Special Bearings for XR-7755 Engine. *S.K.F. Industries, Inc., Release*, Recd. December 4, 1946. 1 p.

Application of antifriction bearings to the sphered crankshafts of the new 5,000-hp. XR-7755 is reported to mark the first use of this type in engines of such large size. The special crankshaft bearings are cylindrical roller bearings whose bores are sphered to fit the engine's sphered crankshaft. One ft. in diameter, and slightly more than 1 in. wide, each bearing weighs less than 15 lbs., but they can take instantaneous peak loads approximating 100,000 lbs. Mounting of the bearings on the crankshaft's sphered seat eliminates the need for locking devices to hold the bearing in position and considerably aids the attainment of a favorable ratio of engine power to weight. The sphered bearings separate the four nine-cylinder banks of the 6,050-lb. engine while standard cylindrical bearings are located at the front and rear of the four-throw crankshaft. S.K.F. Industries, Inc., also supplied accessory bearings for the XR-7755, including a special propeller thrust ball bearing split in half to permit the use of more balls.

Stromberg Injection Carburetor for Small Planes. *Bendix Products Division, Bendix Aviation Corp., Release*, Recd. November 29, 1946. 2 pp.

The Stromberg P.S. Series injection carburetor makes available to private fliers and other users of small planes the advantages of the larger Stromberg injection carburetors. The new carburetor is load compensating, modulating the fuel feed for full throttle, cruising, and idling operations. The fuel flow is automatically reduced to idling requirements when the throttle valve is moved into the idling position and stopped entirely when the manual mixture control is moved into the idle cutoff position, but the system remains full of fuel. The P.S. 5CD Series has automatic compensation for temperature and altitude effects.

The Napier Ducted Cooling Spinner. *The Aeroplane*, Vol. 71, No. 1850, November 8, 1946, pp. 535, 536, illus. (Cf. AER 12/46:49.)

A Fool-Proof Throttle Box. *Handley Page Bulletin*, Vol. 12, No. 140, October, 1946, p. 6, diagr.

A throttle-control device invented by Handley Page, Ltd., features an "instinctive" operating cycle in which the stages that

bring about the change of reversible-pitch propellers from positive thrust to an increasing negative thrust are all associated with the instinctive backward movement of the pilot's throttle-control levers when decelerating the plane. An interlocking arrangement makes it necessary to reduce the engine speed to the slow-running position during the period of pitch change, preventing overrunning of the engine. A visual indication of the pitch setting is provided.

Engines—General

Compounding Aircraft Engines. W. O. Meckley and L. J. Fischer. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 50–52, illus.

Development of the type of power plant in which an exhaust turbine is compounded with a reciprocating engine has reached the stage where test data of various combinations of turbine and piston engines have been made available to check theoretic studies and to give assurance to the potentialities of compounding the piston engine. How obstacles that have prevented the earlier use of this engine-turbine principle are being overcome is described. Curves showing the characteristics of compounded engines are presented. These were prepared from analytic studies but the relative magnitudes were verified by test-stand data. The article is confined to a discussion of the type of power plant in which the power from the exhaust-driven turbine is returned to the engine crankshaft.

A Short History of German Jet Propulsion Development, 1929–1945. *The Aeroplane Spotter*, Vol. 7, No. 174, November 2, 1946, pp. 258–260, illus.

Design Trend of Aircraft Exhaust Systems. Ralph L. Haver and Harry A. Goodin, Jr. *Automotive and Aviation Industries*, Vol. 95, No. 10, November 15, 1946, pp. 40–42, 92, illus. The design of exhaust systems for reciprocating and reaction propulsion engines.

Trends in Aircraft Engines. Robert Insley. *Western Flying*, Vol. 26, No. 11, November, 1946, p. 42.

Small engines are becoming larger whereas large engines are not only expanding but changing character entirely, as in the case of the gas turbine. The enthusiasm for jets and turbines, while thoroughly justified, may perhaps have been too exclusive and for routine, long-range operations, the turbine-compounded piston engine may merit more serious consideration than has been apparent recently. Although the problem of power plants for small airplanes in recent months has been primarily one of the production capacity, there have been engineering advances that fall into three general classifications: power increase, weight reduction, and cost reduction. It is stated that little improvement has been noticed in specific power output except in circumstances that permit higher shaft speeds. Modern methods of stress examination have disclosed important opportunities for reduction of both weight and cost. The use of magnesium in place of aluminum has made decided progress. Drastic reduction in aircraft-engine costs will come from the adoption of automotive methods of manufacture.

British Aero-Engines. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, pp. 588–591, illus. Brief descriptions of 13 engines, with a table giving the specifications and performances of 13 gas-turbine and 25 reciprocating engines.

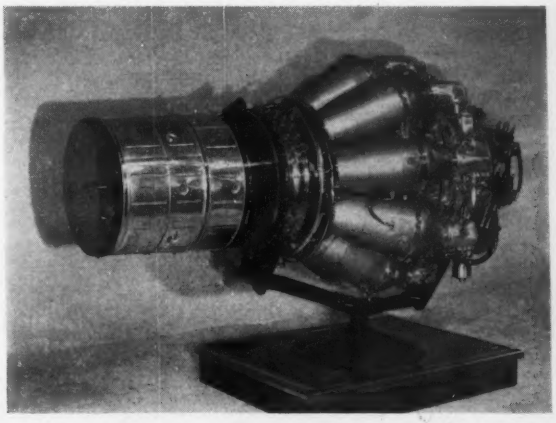
Engines, Gas Turbine

Gas Turbine Engine Performance. H. Serbin. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 78–80, 122, figs.

In a mathematical analysis of an idealized jet engine, an expression is developed for computing the thrust of the engine. The evolution of equations for thermal efficiency factor, velocity ratio, and other functions of airflow and heat absorption are traced. Methods of calculating the thrust of a jet engine with that of a propeller are compared, and the power output of a combined jet and turbine-propeller drive is considered. A basis is suggested for the selection of the best combination to achieve a given designed air speed.

Note on the Use of Ceramics in Gas Turbine Design. S. W. G. Foster. *The Royal Aeronautical Society, Journal*, Vol. 50, No. 431, November, 1946, pp. 893–895, table.

The properties and applications of ceramics in gas-turbine design are discussed, emphasizing their development in Germany and their use in the Siemens turbine.



The Rolls-Royce Nene, the most powerful jet-propulsion engine in current production, has just completed an unusually long running test to American type-test requirements. Its use is being considered by several aircraft manufacturers in this country for advance military and commercial types of aircraft.

The Taylor Turbine Corporation, which has negotiated a license with Rolls-Royce for the manufacturing rights on this engine in America, is headed by Philip B. Taylor, President, and S. T. Robinson, Vice-President, Fellow and Member of the Institute, respectively.

The History of British Gas Turbines. Marcus Langley. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 66–70, illus.

"Theseus I" Propeller Gas-Turbine Aero-Engine. *Engineering*, Vol. 162, No. 4214, October 18, 1946, pp. 368–369, illus. (Cf. AER 11/46:39.)

Gas Turbines of the Future. John W. Smith. *Automotive and Aviation Industries*, Vol. 95, No. 9, November 1, 1946, pp. 40, 41, 67, illus.

An evaluation of gas-turbine cycles indicates that emphasis in research should be placed on high-pressure turbine development. Through the use of temperature-pressure entropy charts, the operating cycle of existing low-pressure turbines is compared with the cycle of a high-pressure gas turbine. Because no specific figures are available on the fuel consumption per hp.-hr. of low-pressure jet turbines, the Carnot cycle is used in fuel-efficiency comparisons. It is stated that the limitations of the low-temperature, low-pressure turbine heat cycle account for the extravagant fuel consumption ranging from 1.5 to 3 lbs. of fuel per hp.-hr. A high-pressure turbine cycle is more efficient and will meet the requirement in fuel economy providing a high-pressure mechanism is used to perform the cycle. Calculations and tests show that it should be possible to commercialize a high-pressure turbine of the type referred to having a fuel consumption of approximately 0.3 lb. per hp.-hr. An exterior view of such a turbine is shown. It has a fuel injection, opposed-piston, two-stroke Diesel engine between the compressor and turbine wheel instead of the burner chamber as in the low-pressure turbine.

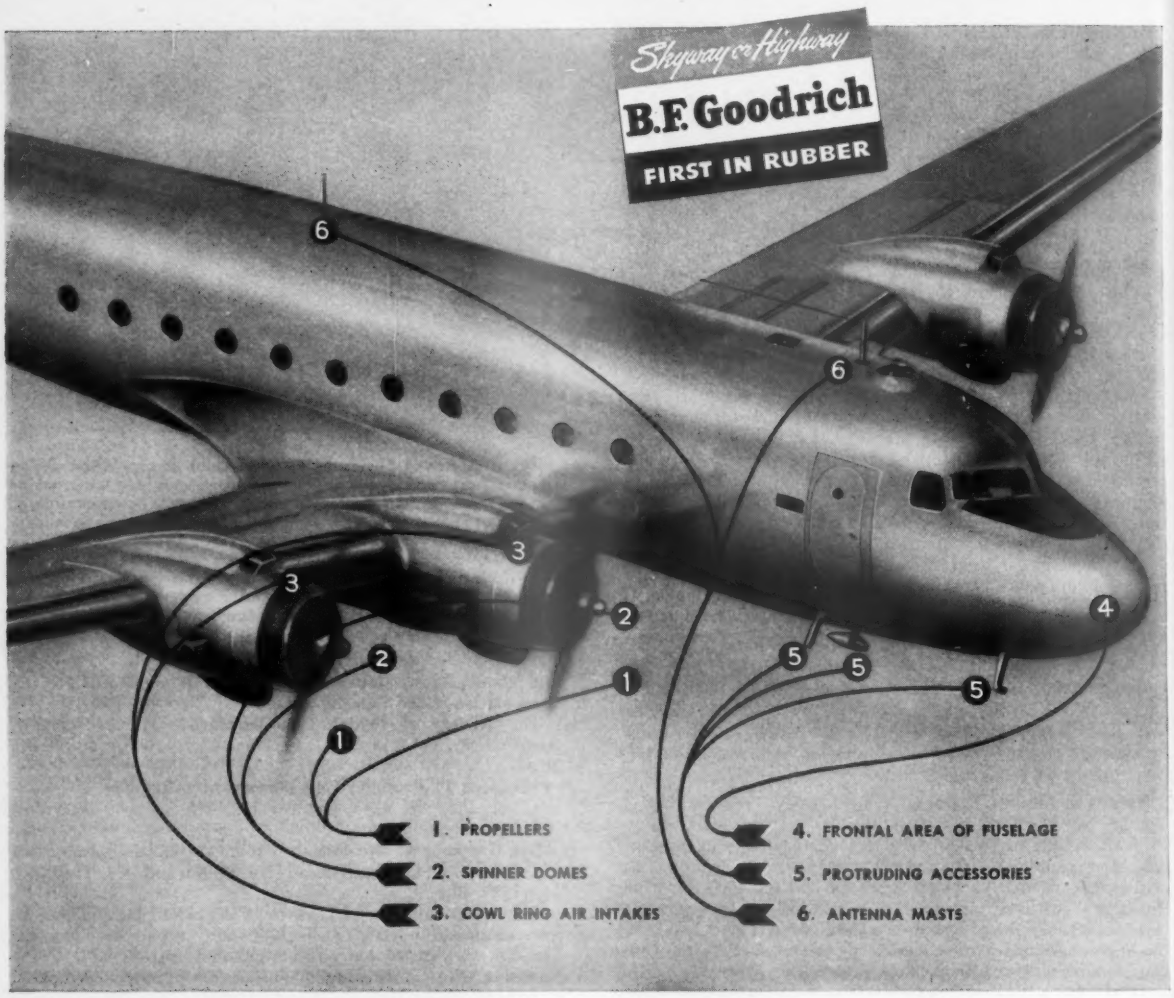
Airscrew Turbine Progress. *Flight*, Vol. 50, No. 1975, October 31, 1946, pp. 466, 467, illus.

A review of English developments with particular reference to power plants awaiting flight tests on the Avro Lancaster, the Avro Lincoln, and other aircraft. The Armstrong Siddeley Python and Mamba engines, and a starter operating on compressed air or a slow-burning cartridge are described.

Engines, Ram-Jet

Project Bumblebee—the Navy's Ram-Jet. Robert W. Bass. *American Rocket Society, Journal*, No. 66-67, July-September, 1946, pp. 32–35.

A brief report on the Navy's kerosene-fueled rocket designed for speeds up to 1,500 m.p.h. also reviews the principles of ram-jet engines. The engine consists of three principal sections: the nose, the combustion chamber, and the exhaust nozzle. The results of experiments with ram-jet models are summarized.



Now rubber makes it hot for ice

AIRPLANE propellers were asking for trouble as they whirled through the air in certain weather conditions. Their leading edges, biting into supercooled moisture droplets, quickly gathered ice—thrust was not maintained, and full engine power wasn't available. Now B. F. Goodrich has developed a heated rubber shoe that concentrates warmth where protection is needed.

This rubber is made in a thin, tough "skin" which fits tightly over almost any regular or irregular shape. Current from a lightweight generator produces heat in the "skin." Resistances are carefully planned so the heat can be closely controlled. Just the right amount of heat reaches just the right places.

Instrument masts, engine cowls, spinner domes and other exterior applications receive enough heat to keep ice from forming. On hydraulic lines, water tanks and other special interior parts, heated rubber "jackets" can be utilized to prevent freezing and maintain flexibility.

Besides the cold weather advantages, these B. F. Goodrich rubber "skins" on exterior accessories offer excellent abrasion-resistance... sturdy protection against sand, pebbles, cinders, and the eroding effects of rain—especially important to propellers. Perhaps heated rubber can help you. For facts, write to *The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

Engines, Reciprocating

Oxygen Injection as a Means of Increasing Aero-Engine Performance. E. P. Hawthorne. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, pp. 330–335, illus.

Military operations may require a sudden increase in aircraft speed or ceiling, which cannot be obtained quickly enough by the normal method of increasing the total mass of air delivered to the cylinders with a supercharger, thus increasing the oxygen content of the air charge and boosting the power output. Oxygen injection methods were tested at the Royal Aircraft Establishment and elsewhere in Great Britain during the war. Fighter aircraft fitted with nitrous oxide injection systems were used operationally with successful results. A nitrous oxide injection system primarily for use on reconnaissance or bomber aircraft was also developed in Germany. An exposition of the theoretic possibilities of obtaining increased power by the injection of oxygen is followed by details of British and German installations. The use of an oxygen or nitrous oxide injection system should be thought of essentially as an emergency method of increasing engine performance at high altitudes which does not adversely affect the normal operating characteristics of the aircraft.

Liquid Oxygen to Boost Aircraft-Engine Power at Altitude. *U.S., National Bureau of Standards, Release*, Recd. November 6, 1946. 2 pp.

Investigations of the effects on engine performance of certain organic nitro compounds, oxides of nitrogen, hydrogen peroxide solutions, and pure gaseous and liquid oxygen indicated that liquid oxygen was the most promising for immediate service application. In flight tests at 28,000 ft., it was found that there was a boost of about 400 hp. with a 39-m.p.h. increase of speed after liquid oxygen injection was started. The total amount of fuel consumed per hp.-hr. decreased slightly. An increase of 200 hp. and 15 m.p.h. was shown at 35,000 ft. The injection of liquid oxygen did not increase the tendency of the charge in the engine cylinder to detonate. However, since the injected oxygen is not accompanied by the usual four volumes of nitrogen, cylinder-head temperatures are higher than during operation using air containing the same total quantity of oxygen. Since these head temperatures approach the limiting permissible values during take-off, the injection of liquid oxygen is to be avoided at all altitudes at which the engine can develop its normal rated power when operated on air alone.

From the standpoint of head temperatures and backfiring, results indicate that the total concentration of oxygen in the inducted charge should not exceed 29 per cent by weight. At lower concentrations, it is safe to increase the power of the engine at altitude by the injection of liquid oxygen, thereby achieving worth-while increases in speed, rate of climb, and ceiling of the airplane. The total weight of the charged oxygen system is about 200 lbs., of which 100 lbs. is liquid oxygen, sufficient for 16 min. of operation at a boost of 300 b.hp. Nineteen tons of liquid oxygen were used without accident during the course of the tests. Although the tests were of experimental nature and no service installation was made, the development of the method was carried to the stage where it could have been applied directly.

Flight Investigation of the Cooling Characteristics of a Two-Row Radial Engine Installation. III—Engine Temperature Distribution. Robert M. Rennak, Wesley E. Messing, and James E. Morgan. *U.S., N.A.C.A., Technical Note No. 1147*, October, 1946. 44 pp., figs. 4 references.

The temperature distribution of a two-row radial engine in a twin-engined airplane was investigated in a series of flight tests. The test engine was operated over a wide range of conditions at density altitudes of 5,000 and 20,000 ft.; quantitative results are presented showing the effects of flight and engine variables upon average engine temperature and overall temperature spread. Discussions of the effect of the variables on the shape of the temperature patterns and on the temperature distributions of individual cylinders also are included. The results indicate that, for the tests conducted, the temperature distribution patterns were chiefly determined by the fuel-air ratio and cooling-air distributions. It was possible to calculate individual cylinder temperature, on the assumption of equal power distribution among cylinders, to within an average of ±14 °F. of the actual temperature. A considerable change occurred in either the spread or the shape of the temperature patterns with a variation in the angle of attack of the thrust axis, the average engine fuel-air ratio, the engine speed, the power, or the blower ratio. Smaller effects on the temperature pattern were noticed with a change in cowl-flap opening and altitude. In most of the tests, a change in conditions affected the temperature of the barrels less than that of the heads. The variation of flight and engine variables had a negligible effect on the temperature distributions of the individual cylinders.

The 2,000 h.p. Hercules. *The Aeroplane*, Vol. 71, No. 1850, November 8, 1946, pp. 542, 543, illus. A description of the Bristol Hercules 230 sleeve-valve 14-cylinder two-row radial engine, and its accessories and installation.

Most Powerful Hercules. *Flight*, Vol. 50, No. 1976, November 7, 1946, pp. 506, 507, illus. (Cf. preceding abstract.)

New Bristol Hercules; Development of Mark 230. *Modern Transport*, Vol. 56, No. 1444, November 16, 1946, p. 7, illus. (Cf. two preceding abstracts.)

The Gipsy Queen Series 70. "Molecule." *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 143, 144, 147, illus. (Cf. AER 3/46:89.) Descriptive.

Leonides Air Tests. *Flight*, Vol. 50, No. 1976, November 7, 1946, p. 491, illus. (Cf. AER 9/46:51.) A summary of the results of flight tests of the 515-hp. Leonides nine-cylinder radial engine installed in an Airspeed Oxford airplane.

Cameron Aircraft Engines. *Cameron Aero Engine Corp., Release*, Recd. November 13, 1946. 13 pp.

Cameron air-cooled engines, consisting of a four-cylinder in-line inverted engine designed for 125 hp., a six-cylinder inverted engine designed for 185 hp., and a twelve-cylinder V inverted engine designed for 370 hp., have been designed to meet present and future requirements. The four-cylinder engine is of in-line cylinder arrangement and is air-cooled. The engine may be mounted in inverted or upright position, necessitating only slight changes in oil leads. The bore and stroke are $4^3/_4$ in. and $4^1/_4$ in., respectively, giving a total piston displacement of 301 cu.in. The compression ratio is 6.40:1 and the engine develops 125 b.hp. at 2,500 r.p.m. using standard aviation fuel. The total dry weight of the production model of the four-cylinder engine will be approximately 200 lbs.

A New British Engine in Paris. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, p. 557, illus.

A flat-six sleeve-valve engine built by Roy Fedden, Ltd., developing 185 hp. with gearing, is equipped with fuel injection and a novel air-cooling system. It can be installed in a wing 14 in. thick.

Fedden Flat-Six Engine. *Flight*, Vol. 50, No. 1977, November 14, 1946, p. 520, illus. (Cf. preceding abstract.)

Nuffield Flat-Four. *Flight*, Vol. 50, No. 1977, November 14, 1946, p. 541, illus.

Some details of the (British) Nuffield four-cylinder opposed engine for light aircraft. It is air-cooled, has overhead valves, and is designed to develop 100 hp. at 2,600 r.p.m.

Diesels for Private Planes. Robert C. Hare. *Air World*, Vol. 6, No. 2, January, 1947, pp. 16, 54, illus.

A four-cylinder, opposed air-cooled engine, developing 125 hp. at 2,600 r.p.m. was designed by Fred A. Thaheld and built as a prototype by Shaffer Tool Works, of California. By a simple adjustment of stroke in the fuel injection pump it can be run at 100 hp. at 2,400 r.p.m. It is stated that the engine will propel a small airplane at 95 m.p.h. with a fuel consumption of less than 3 gal. per hour.

Engines, Rocket

Adiabatic Expansion of a Gas Stream Containing Solid Particles. W. R. Maxwell, W. Dickinson, and E. F. Caldin. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, pp. 350–351. 5 references.

The theoretic treatment usually applied to the behavior of rocket engines is applicable only when the working substance is entirely gaseous. Many rocket propellants, such as gunpowder, yield combustion products that contain a considerable proportion of solid or liquid particles, and therefore are disperse systems or "smokes" rather than gases. If temperature equilibrium is maintained between solid and gas during expansion, the condensed particles contribute considerably to the heat capacity, but negligibly to the work done in expansion. The standard expressions for the gain of kinetic energy and the relation between thrust and pressure must all be modified. The adiabatic expansion of a stream of such a smoke is considered, and an equation of state for the system is derived on simple assumptions. Expres-

sions are derived for the gain of kinetic energy and other characteristics.

The Exponential Law of Motion. Cedric Giles. *American Rocket Society, Journal*, No. 66-67, June-September, 1942, pp. 37–42, illus.

The exponential law of motion for determining the ratio between the weight of the fueled and the empty rocket is clarified. Although the subject has been treated to some extent in most technical works on rockets, in many cases owing to the absence of certain fundamental considerations or the advanced mathematical calculations involved, a general understanding of the exponential expression is often difficult. The explanation includes the mathematical theory and its application to the calculation of acceleration, altitude, and velocity.

Rocket Propulsion. R. W. Porter. *The Coast Artillery Journal*, Vol. 5, No. 5, September-October, 1946, pp. 13–15.

The economic and military aspects of long-range supersonic rockets and guided missiles and the principles of rocket propulsion are summarized in semitechnical terms. Static-test methods for measuring the thrust, jet velocity, and other characteristics, and formulas for computing power, efficiency, and the theoretic value of jet velocity are considered, as well as weight ratio and the problem of cooling. Advances in the field of rocketry should follow each other rapidly with the development of better materials, new propellants, and perhaps the use of some form of atomic energy. Improved structural design and greatly increased sizes are to be expected.

Rockets In War. Irving J. Harrell, Jr. *Army Ordnance*, Vol. 31, No. 159, November-December, 1946, pp. 249–251, illus.

A history of rocket weapons is followed by descriptions of recent types developed in Germany, Great Britain, and the United States, and by notes on the general design and performance of free rockets (as distinguished from guided missiles).

The Rating of Rocket Fuels. Thomas S. Gardner. *American Rocket Society, Journal*, No. 66-67, June-September, 1946, pp. 23–26.

Atomic energy is considered as a primary heat source for rocket propulsion. An examination is made of some of the theoretic uses of atomic energy as a rocket drive, on the assumption that atomic energy derived from small amounts of atomic fuel can provide a constant, controllable, high-temperature heat source. Analytic processes are applied to the concept and certain assumptions are made with regard to secondary fuel conditions.

Atomic Hydrogen—The Fuel of the Future. Louis C. Young. *American Rocket Society, Journal*, No. 66-67, June-September, pp. 35–37, illus.

A uranium pile producing atomic hydrogen would provide rocket fuel 31 times more powerful than chemical fuels and seven times more powerful than atomic hydrogen as utilized for welding. A possible design for a subatomic engine is described.

The Problem of Interplanetary Propulsion. L. R. Shepherd. *British Interplanetary Society, Bulletin*, Vol. 1, No. 9, November, 1946, pp. 55–65, diagr.

Reduced to its simplest aspect, the problem of the projection of vehicles outside the earth's gravitational field is one of developing an engine capable of ejecting dense streams of matter (charged particles or neutral molecules) at a high velocity. Consideration is given to jet propulsion based on thermodynamic principles and the utilization of nuclear energy. The design of a hydrogen propulsion unit is described.

Into Space. Eric Burgess. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 52–57, figs.

The possibilities of circumterrestrial and interplanetary flight, determined from present development and limitations of the rocket as a prime mover.

Fire Prevention

Engine Fires in Aeroplanes. M. Neal. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, p. 352.

An account is given of fire-prevention methods used by the R.A.F. in aircraft powered by reciprocating engines. The requirements established about 1937 were unsatisfactory when applied to modern aircraft with high-powered engines. A standard drill for attacking engine fires was adopted.

Fire Fighting Modernized. David E. Wolda. *The Log of Navigation and Aviation*, Vol. 4, No. 7, November, 1946, pp. 8, 9.

A description of fire-fighting and rescue equipment being developed by the Army Air Forces.

Flight Technique

"Dear Student . . ." IV—Your Landing Gear. Wolfgang Langewiesche. *Air Facts*, Vol. 9, No. 11, November, 1946, pp. 54–58, diagr. Instructions in take-off, landing, and taxiing for the student pilot.

Flight Testing and Performance

An Analysis of the Airspeeds and Normal Accelerations of Douglas DC-3 Airplanes in Commercial Transport Operation. A. M. Peiser. *U.S., N.A.C.A., Technical Note No. 1142*, September, 1946. 22 pp., figs., tables. 7 references.

The report is the second prepared to give the results of an analysis of V-G data from commercial transport airplanes. The first report dealt with data obtained from Boeing S-307 airplanes flying in the Caribbean region. The present report is concerned with an analysis of data obtained with Douglas DC-3 airplanes flying over three transcontinental routes in the United States. The data were analyzed to indicate the influences on airplane life of route, dispatching, and forecasting practices, and of operating speed on the applied loads experienced during commercial transport operation. The operational life of airplanes was found to be directly related to the operating speeds maintained in regions of turbulence and to the forecasting facilities and dispatching practices of the air line. During a given period of operation, however, for transcontinental operation in the United States, differences in route roughness appear to be so compensated for by the forecasting and dispatching practices of the air lines that route, as a significant parameter in airplane life, may be neglected.

An Analysis of the Airspeeds and Normal Accelerations of Boeing S-307 Airplanes in Commercial Transport Operation. A. M. Peiser and W. G. Walker. *U.S., N.A.C.A., Technical Note No. 1141*, September, 1946. 28 pp., figs., tables. 8 references.

Acceleration and air-speed data in the form of V-G records from three Boeing S-307 airplanes operated by Pan American Airways were analyzed to determine the effects of prewar and war operation and of the season of the year on the applied loads experienced during commercial transport operation. A total of 305 V-G records representing 17,068 hours of flight was selected from the quantity of data available for use in evaluating the actual flight loads imposed on commercial transport airplanes and in determining the effect of airplane characteristics, operating speeds, terrain, and season on the applied loads for which the wing structures of new airplanes must be designed. Greater loads were found to be imposed on the airplanes during the war period than during the prewar period. Flights during the war period were generally made through regions of greater turbulence, and operating speeds in this period were less conservative. No significant differences were determined among the data for seasonal operation within the war period. Operating speeds, however, tended to be more conservative during the months of July, August, and September.

Performance Data Presentation. Norman N. Rubin. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 46, 47, 103, 104, illus.

Calculated or flight-test performance data for aircraft and engines can be variously presented, the principal classifications being graphical or tabular. Both forms are evaluated and compared, with comments on the degree of accuracy required. Standard instruments and methods of recording performance figures are recommended.

Vacuum Tube Acceleration Pickup. *National Bureau of Standards, Release ES-1019*, Recd. November 21, 1946. 2 pp.

A new electronic tube, resembling an ordinary radio tube but capable of accurately measuring the rapidly changing accelerations to which various parts of an airplane are subjected in flight, has been developed at the National Bureau of Standards. The new tube, known as the vacuum tube acceleration pickup, is also proving useful in such applications as the measuring of accelerations in portions of the body of "dummy" pilots and living subjects when subjected to critical acceleration during forced landings or seat ejections from airplanes.

Fuels

The Effect of Engine Variables on the Preignition-Limited Performance of Three Fuels. Donald W. Male. *U.S., N.A.*

C.A., Technical Note No. 1131, September, 1946. 37 pp., figs. 3 references.

Preignition-limited performance data for three types of fuels—S reference fuel, diisobutylene, and benzene, were obtained with an engine-heated hot spot on a supercharged CFR engine at eleven sets of engine-operating conditions. Increases in compression ratio, spark advance, coolant temperature, or inlet-air temperature decreased the preignition-limited indicated mean effective pressure of all three fuels. Changes in the engine speed either raised or lowered the preignition-limited indicated mean effective pressure depending on the range of speed and the mixture strength. At nearly all the operating conditions investigated, the order of the fuels according to increasing preignition-limited performance was the same, that is, (1) diisobutylene, (2) benzene, and (3) S reference fuel.

Comparison of Relative Sensitivities of the Knock Limits of Two Fuels to Six Engine Variables. Harvey A. Cook, Louis F. Held, and Ernest I. Pritchard. *U.S., N.A.C.A., Technical Note No. 1117*, August, 1946. 21 pp., figs.

A sensitive fuel (42 per cent S reference fuel, 40 per cent toluene, and 18 per cent M reference fuel by volume + 4 ml TEL/gal; grade 103/145) and a relatively insensitive fuel (100 per cent S reference fuel + 4 ml TEL/gal; grade 153/153) were knock-tested in a full-scale air-cooled cylinder. Sensitivity was indicated by different degrees of knock-limited response to changes in engine conditions. Six engine variables were investigated: (1) fuel-air ratio, (2) compression ratio, (3) inlet-air temperature, (4) spark advance, (5) exhaust pressure, and (6) cylinder temperature.

The relative changes in the knock-limited indicated mean effective pressure and charge-air flow of the two fuels were different for the six engine variables and, except for cylinder temperature, varied over the range investigated. These results indicate that in order to correlate the effects of engine variables on knock-limited performance of fuels, more basic knock factors than knock-limited indicated mean effective pressure and charge-airflow are required. Fuel-air ratios above the stoichiometric showed the greatest relative sensitivity of the knock limits of the two fuels, except for tests at high exhaust pressure. The relative sensitivities shown in fuel-air-ratio and exhaust-pressure tests became more consistent with those for the other engine variables when the fuel-air-ratio data were compared on a percentage excess fuel basis rather than on a fuel-air basis, and the exhaust-pressure data were compared on either an exhaust-to-inlet-pressure ratio or inlet-to-exhaust-pressure difference basis rather than on the basis of exhaust pressure.

Gliding and Soaring

A Case for Glider Manufacturing in Australia. S. L. Kucharzewski. *Air-Log* (Sydney), Vol. 8, No. 7, September, 1946, pp. 26–28, diagr. Includes specifications of the primary training glider, "Wren," designed by W. Czerwinski and A. Tarczynski, of Toronto, Canada.

History

A World Record Résumé. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 71–74.

Hydraulic Equipment

Hydraulic Systems in German Aeroplanes. I—The Messerschmitt Me 262 and Me 410. M. Hodgson. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, pp. 347–349, diagrs. (Excerpts from *Combined Intelligence Objectives Sub-Committee Report XXXI-41.*) Descriptive.

Vickers Hydraulic Equipment for Aircraft. *Vickers, Inc., Bulletin No. 46-41*, 1946. 8 pp., illus.

Descriptions and performance graphs of a group of hydraulic pumps, accumulators, unloading valves, relief valves, pressure-reducing valves, and brake valves for aircraft use. Brief specifications of each type of equipment are accompanied by illustrations and reproductions of performance graphs.

Ice Prevention

Notes on Possible Equipment and Technique for Experiments on Icing on Aircraft. G. I. Taylor. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2024*, January 15, 1940. 7 pp., fig. British Information Services, New York, $0.45.

The writer reviews the application of the theory governing the formation and behavior of water drops to research work in ice prevention by means of a refrigerated wind tunnel. He calls attention to some of the directions in which the theory might be expected to give a lead to experimental work and also to help in the design of a tunnel. Equations of motion of a drop in a steady stream with given components are developed and applied to the calculation of the frequency with which drops strike various parts of the surface near the leading edge of an airfoil. Other expressions are worked out for the calculation of the size of the drops.

Development of a Protected Air Scoop for the Reduction of Induction-System Icing. Uwe von Glahn and Clark E. Renner. *U.S., N.A.C.A., Technical Note No. 1134*, September, 1946. 71 pp., figs., tables. 3 references.

Aerodynamic, rain, and icing tests were conducted in the N.A.C.A. icing-research tunnel on the standard carburetor air scoop of a large twin-engined cargo airplane and on several undercowling scoops designed in an effort to eliminate the characteristic ram-pressure loss accompanying impact icing of the standard scoop and the carburetor screen. Tuft and static-pressure-distribution surveys were made on the lips of the scoops and total-pressure and static-pressure readings were taken at the carburetor top deck to determine ram-pressure recovery and velocity distributions. Rates of water ingestion were determined at three simulated flight and rain conditions. Icing tests of the various scoops were made to determine the amount of duct and carburetor-screen icing. The aerodynamic surveys indicate that an undercowling scoop of the type investigated in these tests can achieve ram-pressure recovery comparable with that of the standard scoop. The results of the rain-ingestion tests indicate that the undercowling-type scoop ingests less than 5 per cent of the free water in the air entering the induction system as compared with the standard scoop. The icing of the carburetor screen with the undercowling scoop was negligible, whereas with the standard scoop it was excessive.

Electrical Anti-Icing of Aircraft Windshields. J. D. McCrumm. *Electrical Engineering*, Vol. 65, No. 12, December, 1946, *Transactions*, pp. 786–791, figs. 5 references.

Basic considerations for the design of a windshield anti-icing system are examined. Impact resistance is regarded as the major secondary consideration. Attention is given to ways in which thermal energy is removed from a heated windshield flown in an icing environment, and to factors influencing the adoption and design of electrical and nonelectrical anti-icing schemes. A windshield designed for a pressurized Douglas airplane is expected to provide freedom from icing under severe conditions at any operating speed or altitude.

Airscrew De-Icing Advance. *The Society of British Aircraft Constructors Ltd., Release A.1395*, November 7, 1946, p. 3.

The primary object of a new method of propeller deicing developed by Rotol, Ltd., is to prevent the leading edge of the blade from becoming iced and to keep it bathed in the protective fluid. The fluid is drawn from a supply tank by an electrically operated pump and delivered to a rotating slinger ring anchored to the propeller hub. From this slinger ring, independent pipes shaped to the contour of the hub and leading to the root of each blade feed into an inverted rubber trough which is cemented to the blade root and forms part of the feed shoe. Several holes in the inverted trough direct the fluid into grooves, in which it is carried the full length of the shoe by centrifugal action.

Instruments—General

An Electronic Balancer. *The Engineer*, Vol. 182, No. 4740, November 15, 1946, p. 441, illus.

Description of the Reed and Sigrist, Ltd., electronic balancer for static-dynamic balancing and "left-right" balancing. Its uses include balancing a gyroscope rotor.

An Electronic Frequency Meter and Speed Regulator. Ellis Levin. *Electrical Engineering*, Vol. 65, No. 12, December, 1946, *Transactions*, pp. 779–786, illus.

For the measurement and regulation of speeds ranging from 10,000 to 100,000 r.p.m., a frequency meter was designed which can also be used as a general laboratory instrument for the accurate indication of small deviations from a given frequency. The

FLYING COLORS! Even surpassing predicted performance, Martin 2-0-2 is passing tests in record time. The pilots say, ". . . more get up and go than any non-military plane . . . can't imagine any plane having better handling characteristics and more satisfactory stability, either directionally, longitudinally or laterally . . . new airfoil design proving most successful!"

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indication is stable to about one or two r.p.m. under normal line voltage variations and it can be made accurate to approach one-tenth of one per cent. A photoelectric "pickup" is employed, obviating a mechanical connection to the rotating shaft. It is actuated by the alternation of black and polished areas on the surface of the shaft and indicates the speed by measuring the frequency of an electric signal. The device is essentially an electronic frequency meter of the recurrent capacitor discharge type, modified to operate as a "null-balance" circuit instead of a direct-reading device. The various circuits are analyzed.

Index to Flight Control. *Bendix Aviation Corp., Eclipse-Pioneer Div., Publication No. 68-22A*, 1946. 29 pp., illus.

A catalog gives details about the Eclipse-Pioneer line of flight-control instruments for personal airplanes. It contains information about a basic instrument panel containing flight-control and power-plant instruments, data for use in the selection of instruments for the basic panel, and descriptions of individual instruments.

Instruments, Engine

Improved Electronic Engine Indicator. A. H. B. Walker. *Engineering*, Vol. 162, No. 4214, October 18, 1946, pp. 361–364, illus.

An electronic device for recording pressure-time curves in the testing of engines and air compressors was designed in accordance with the characteristics that a theoretically perfect instrument of that type should possess. These characteristics and circuit and layout diagrams are given. The required performance is unattainable without the use of a capacity type of pressure head.

Instruments, Flight

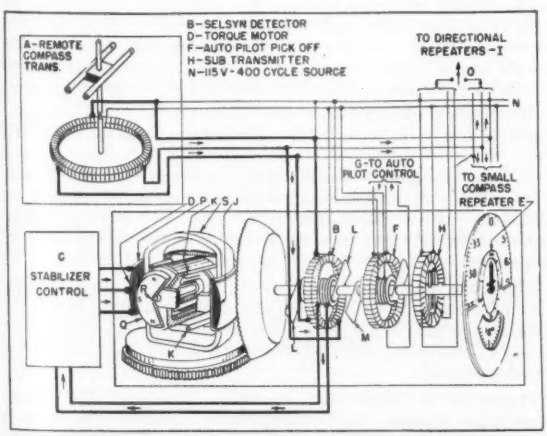
An Improved Azimuth Indicating System for Aircraft. E. E. Lynch and R. A. Pfuntner. *Electrical Engineering*, Vol. 65, No. 12, December, 1946, *Transactions*, pp. 806–812, illus. 8 references.

The paper summarizes the design progress ranging from direct-reading compasses to monitored gyroscopes and concentrates on the problems in aircraft where space limitations, reliability, and operation at all altitudes are important. Azimuth indicators and automatic-pilot controls close to the ideal are obtainable by the use of special features, such as a "nontumbling" mechanism and an electromagnetic type of gimbal adjusting device.

Air Mileage Recorder. E. E. Trett. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, p. 32, diagr.

The resultant force of the pitot and static pressures controls the speed of an electric motor so that the shaft rotates proportionally to the true air speed of the aircraft. The shaft is geared down and coupled to the transmitter containing a contacting device that energizes the solenoid to rotate the counters each time the aircraft covers one-tenth of a nautical mile.

Towards Complete Automaticity; Sperry A.12 Electrically-Operated Automatic Pilot Described; The Gyrosyn Compass. *Flight*, Vol. 50, No. 1975, October 31, 1946, pp. 463–465, illus.



Schematic diagram of General Electric azimuth indicating and control system. (See "An Improved Azimuth Indicating System for Aircraft.")

Landing Gear

The Drift Undercarriage. A. Falorde. *Aeronautics*, Vol. 15, No. 4, November, 1946, p. 58, diagr.

Methods of enabling aircraft to land and take-off independently of the wind direction, and in shorter distances, are discussed with reference to a device developed by Owen F. Maclaren, which has been under trial for over 8 years. The aircraft is provided with an undercarriage, the wheels of which can be set at an angle to the fore-and-aft line of the fuselage. Test results are tabulated.

A New Approach in Designing High-Capacity Aircraft Brakes. Byron H. Shinn. *Product Engineering*, Vol. 17, No. 11, November, 1946, pp. 140–143, illus.

The design and development of the Firestone aircraft brake, which is based on different concepts from the usual, are described. The properties and suitability of copper for the friction surfaces of brakes are compared with those of the ferrous metals. Reasons are given why the rated capacity in foot pounds of kinetic energy per pound of brake and wheel assembly does not increase proportionally with an increase in the weight and size in brakes of identical type.

New Hydraulic Cylinders Meet Rigid Operational Needs. H. J. Marx and J. J. Mancusi. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 58–61, illus.

Factors to be considered in the design of power brakes are enumerated and discussed. One problem, the provision for "load feel," has presented difficulties. A unit consisting of compounding cylinders has been developed to meet the high-energy requirements for the hydraulic operation of brakes and control surfaces. A part of the braking force is supplied by the pilot.

Airplane Tire Containing Wire Cords. *United States Rubber Co., Release*, Recd. November 19, 1946.

The foundation structure of the tire is made of fine, flexible steel wire, affording a smaller tire of greater carrying capacity. The need for such a tire results from the thinner airfoils of high-speed airplanes, which restrict the amount of space for retracted tires. An experimental six-ply 15.50 tire was designed to carry loads of 20 tons, approximately twice the load carried by the present tire of the same size. Although a set of four wire-cord tires of this size would probably permit 80-ton loads, far greater plane loads would be possible with larger-size wire tires. The particular tire referred to weighs 230 lbs. and has a normal air pressure of 250 lbs. per sq.in. Its designers estimate, however, that it could be inflated to 1,700 lbs. before bursting.

Lubrication and Lubricants

Lubrication Chart DC-4. *Douglas Service*, Vol. 4, No. 11, November, 1946, pp. 10, 11, illus.

Maintenance

Corrosion Is No Accident. H. E. Smith, Jr. *Mechanical Engineering*, Vol. 68, No. 11, November, 1946, pp. 943–948, illus.

The investigations described indicate that frequent inspection and cleanliness in aircraft maintenance are important factors in the prevention of corrosion in aircraft structures. Two types of corrosion in Alclad are defined. A study of corrosion in 80 C-47 aircraft assigned to the Pacific area determined that it was caused by improper maintenance and inspection.

Mechanics Corner: Repair of Structural Tubing. Lee Brady. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 52, 53, 153, diagrs.

A review of various methods, with particular reference to welding. Instructions are given for using templates, preparing the tubing, avoiding corrosion, maintaining alignment, and performing the weld.

Spar Web Repair. *Douglas Service*, Vol. 4, No. 11, November, 1946, pp. 18, 19, illus.

A standard method of repairing wing-spar web cracks is suggested, by the use of an "hour-glass" type of doubler. Instructions are given for the work to be performed in making the repair, including a description of the doubler, and directions for installing it and sealing the seams.

Hydro-Aire Valves. *Douglas Service*, Vol. 4, No. 11, November, 1946, pp. 12, 13, illus.

Instructions for the proper assembly and servicing of the fuel-tank selector valves of the Douglas DC-4 airplanes. A procedure

for correcting leakage and for preparing the valves for service after storage for long periods is recommended.

Up-To-Date Rigging for DC-4 Flight Controls. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 73–75, diagrs.

Check That Air Compressor. Frank V. Faulhaber. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 60, 111, illus. Suggestions for the proper operation of portable air compressors used at airports for servicing and maintenance.

Materials—General

Material Strength Data for Tool and Die Design. *The Iron Age*, Vol. 158, No. 22, November 28, 1946, p. 46. Tabulated data regarding the average ultimate strength of metals and other materials for machining and working were compiled from numerous sources by the E. W. Bliss Company.

Materials—Metals and Alloys

Properties of Various Alloys at Sub-Zero Temperatures. *The Iron Age*, Vol. 158, No. 20, November 14, 1946, p. 75.

The results of an investigation carried out by the engineering research laboratory of North American Aviation, Inc., to determine the mechanical properties of various ferrous and nonferrous alloys at −320°F., indicated that the tensile and yield strengths of all alloys tested were greater at sub-zero than at room temperatures. The mechanical properties of seam and arc-welded joints of the various alloys at room temperatures and at −320° F. are compared.

Alloys for High Temperature Service. I, II. W. O. Binder. *The Iron Age*, Vol. 158, Nos. 19, 20, November 7, 14, 1946; pp. 46–52; pp. 92–95, illus.

I. The qualifications of metals and methods of evaluating heat-resistant alloys are discussed, comparing prewar alloys with those recently developed. Various alloying elements were found to improve the properties at high temperatures.

II. Strain hardening, heat-treatment, and grain-size control can enhance desirable qualities of the various alloys, as shown by quantitative data. Fatigue endurance, damping capacity, and weldability are important in determining the suitability of alloys for use at high temperatures.

Jet Materials Progress Slow; Search for Heat Resistant Alloys. *Aviation News*, Vol. 6, No. 23, December 2, 1946, pp. 17, 20. The problems involved and the progress that is being made in the development of heat-resistant materials for gas-turbines are discussed.

Stress Rupture of Heat-Resisting Alloys as a Rate Process. E. S. Machlin and A. S. Nowick. *U.S., N.A.C.A., Technical Note No. 1126*, September, 1946. 24 pp., figs. 9 references.

The equations of the theory of rate processes are applied to stress rupture and predict the experimental stress and temperature dependence of the time for rupture for three heat-resisting alloys. Although this successful prediction for three alloys did not conclusively prove that stress rupture was a rate process, it did provide a basis for recommending that the rate-process stress-rupture equations obtained should be used to interpolate and extrapolate data for different temperatures and to reduce the number of stress-rupture tests. It is indicated that stress may have an effect on the crystal structure by causing a phase change. Also, it appears that the same rate-process mechanism is responsible for both transcrystalline and intercrystalline failure and that a correlation may exist between stress rupture and creep. The recommendation is made that the method of presenting stress-rupture data on a semilog plot (logarithm of rupture time against stress), which has a basis in theory, be investigated for use in place of the present empiric method of presenting stress-rupture data on log-log plots of time for rupture against stress.

Alloy S-816—The Jet and Turbine Steel. Thomas Y. Wilson. *Steel Processing*, Vol. 32, No. 11, November, 1946, pp. 707–709, 723, tables.

The characteristics of S-816 alloy steel, developed by Allegheny Ludlum Steel Corporation to meet the requirements for gas turbines, include great strength at high temperatures. The chemical composition and physical structure, and methods of testing and fabricating this alloy are described.

Evaluation of Two High-Carbon Precision-Cast Alloys at 1,700° and 1,800°F. by the Rupture Test. E. E. Reynolds, J. W. Freeman, and A. E. White. *U.S., N.A.C.A., Technical Note No. 1130*, September, 1946. 25 pp., figs., tables. 5 references.

Information regarding the performance of two precision-cast alloys at 1,700° and 1,800°F. was obtained by rupture tests. The NT-2 tested was essentially a 30-per-cent-nickel modification of alloy N155 with 1 per cent carbon and with the columbium replaced by 2 per cent tantalum. The VT2-2 was Vitallium alloy modified with 1.2 per cent carbon and 2 per cent tantalum. The NT-2 type alloy was heat-treated prior to testing while the VT2-2 type alloy was left in the as-cast condition because experience had shown that these conditions developed the best properties in the alloys. The results obtained indicate that the NT-2 type alloy was stronger than the VT2-2 type for time periods longer than 10 hours. The rupture strengths of the NT-2 type alloy compared favorably with those of the best alloy, X-40, previously tested at 1,700° and 1,800°F. The modified Vitallium alloy was superior in rupture strength to the standard Vitallium alloy for time periods up to about 1,000 hours. Data from tests at 1,500° and 1,600°F. made for the Bureau of Ships, Navy Department, at the Massachusetts Institute of Technology were used to show the effect of temperature on the properties of the alloys in the rupture test. Stress-time-for-rupture data were plotted using stress and log rupture time as coordinates and also log stress and log rupture time as coordinates. On the semilog plot the data were best represented by a single straight line, while on the log-log plot a break occurred in the straight-line relationship.

Internal Stress in Aluminium-Alloy Parts. L. E. Benson. *Engineering*, Vol. 162, No. 4218, November 15, 1946, p. 463, tables. (Summary of an address.)

Effect of Ratio of Rivet Pitch to Rivet Diameter on the Fatigue Strength of Riveted Joints of 24 S-T Aluminum-Alloy Sheet. Harold Crate, David W. Ochiltree, and Walter T. Graves. *U.S., N.A.C.A., Technical Note No. 1125*, September, 1946. 19 pp., figs., tables.

An extensive series of tests was conducted on riveted joints to determine the effect of rivet size and rivet pitch on the fatigue life of joints subjected to "prying" (combined tensile and bending) loads. For each sheet thickness tested there appeared to be a value of the ratio of rivet pitch to rivet diameter that would ensure a near maximum of the ratio of fatigue strength to static ultimate strength for the joint.

Increasing the Compressive Strength of 24S-T Aluminum-Alloy Sheet by Flexure Rolling. George J. Heimerl and Walter Woods. *U.S., N.A.C.A., Technical Note No. 1119*, August, 1946. 13 pp., figs. 5 references.

The sheet was alternately bent and then straightened by rolling in a four-step procedure. The results showed that the greatest increase was in compressive yield stress in the with-grain direction regardless of the direction of rolling; the increase was greater as the radius of flexure rolling became smaller and as the number of steps was increased. The tensile properties, however, were little affected.

Outstanding Properties of Magnesium-Zirconium Alloys. I, II. C. J. P. Ball. *Aluminum and Magnesium*, Vol. 3, Nos. 1, 2, October, November, 1946; pp. 20, 21, 41, illus.; pp. 12, 13, 15, 19, illus. (Excerpts from an address.)

Magnesium Electron Limited developed magnesium-zirconium alloys having improved physical and mechanical properties for aeronautical and other applications. Difficulties with flux contamination in alloying zirconium with magnesium were overcome by the use of a fluoride process. The mechanical properties of zirconium-alloy sheet, extrusions, and die castings are tabulated.

Weathering—Appreciation and a Study. G. D Chapman. *Light Metals*, Vol. 9, No. 106, November, 1946, pp. 593–608, illus.

Typical examples of the following groups of cast light alloys were chosen for atmospheric exposure studies: aluminum-silicon, aluminum-silicon-copper, aluminum-copper, and aluminum-magnesium. The results are summarized. X-rays can be used to demonstrate the type and degree of corrosion.

Aluminum Casting Alloys. *American Smelting and Refining Co., Federated Metals Div., Catalog*, 1946. 41 pp., illus. Information about the metallurgy of aluminum casting alloys, with the specifications for sand, permanent mold, and die castings, and foundry practice.

Properties of Magnesium Products. *American Magnesium Corporation, Catalog*, 1946. 43 pp., illus., tables. The properties, fabrication, finishing, chemical treatment, and availability of magnesium-alloy castings and wrought products are given.

This Tubing Has Double Wall Strength. *Inco*, Vol. 20, No. 4, Fall Edition, 1946, pages 12–14, 28, illus.

The construction, properties, and uses of Bundyweld nickel tubing and Bundyweld Monel tubing are described. The tubing is produced in standard sizes from $^3/_{16}$ in. to $^5/_8$ in. outside diameters and in lengths up to 100 ft. in certain diameters. Double-wall construction gives it resistance against denting, collapsing, or any tendency to burst under pressure. The edges are beveled so that there is no appreciable thickening at the joints. The tubing is made by plating strips of Monel or nickel with a bonding metal and then continuously rolling the strip laterally. It can be bent, coiled, flanged, flattened, upset, expanded, swaged, or brazed for joints and fittings. The ultimate strength, yield strength, elongation, and hardness properties are tabulated.

Development of the 16-25-6 Alloy at the Timken Roller Bearing Co. *Steel Processing*, Vol. 32, No. 10, October, 1946, pp. 656–660, illus.

Investigations conducted to find a material that would maintain strength and atmospheric resistance at high temperatures led to the adoption of the 16-25-6 alloy. Forging and rolling proved unusually difficult because of extremely high hardness at working temperatures. The difficulties were overcome by a careful study of the microstructure of the alloy. Details of cold working and the results of hardness and temperature investigations are given. Chemical and physical properties are listed.

Materials—Plastics and Plywood

Theory of Sandwich Construction. II. A. Garrard. *British Plastics*, Vol. 18, No. 209, October, 1946, pp. 451–458, illus.

Additional information for aircraft designers is presented regarding the structural qualities of sandwich structures comprising thin strips or sheets of metal or plywood connected to backing or supporting members of light, rigid expanded materials. The small amount of published data on the strength or stiffness of these composite structures available to the engineer deals with the probabilities of failure mathematically and experimentally and is mainly concerned with the behavior in compression of plane specimens of extremely limited dimensions. In practice, however, sandwich and similar constructions may be applied to extensive areas and may curve in one or two directions.

Thermal Properties of Plexiglas. *Rohm & Haas Co., Bulletins*, Recd. November 13, 1946. 10 pp., figs.

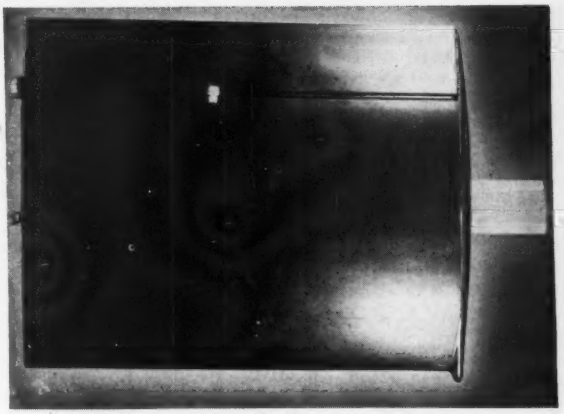
Technical data sheets give details about the determination of the coefficient of thermal expansion of dried Plexiglas I-A including an equation, a graph, and instructions for making the calculations in connection with design work. Similar instructions are given for the computation of specific heat and the coefficient of thermal conductivity. The application and procedure are described. The data sheets contain graphs showing the interfacial coefficient of heat transfer of the material, plotted against air speed at temperatures ranging from −50° to 0°C. The method for calculation of total heat transfer also is given. An alignment chart for calculating the heat transfer from air to air through Plexiglas panels is contained in other data sheets.

The Significance of Gap Filling Assembly Adhesives. *Aero Research Technical Notes*, Bulletin (Cambridge, England), No. 47, November, 1946, pp. 1–4, diagrs.

Some simple tests were made to illustrate the difference in behavior of Aerolite K (a nongap-filling urea formaldehyde adhesive) with Aerolite 300. Six specimens were made with Aerolite 300 and hardener GBP, applying the resin to one of the surfaces and the hardener to the other, and these were tested after 4 months' storage at 25°C. The failing loads were 95, 85, 95, 50, 80, and 55 lbs., giving an average of 76.6 lbs. Six similar test specimens, made with Aerolite K to which 10 per cent of hardener CHW had been added, fell to pieces while being cut to shape after the 4 months' storage. On the other hand, test specimens made under pressure showed that Aerolite K plus CHW was as good as Aerolite 300 plus GBP. The failing loads of Aerolite 300 with GBP ranged from 60 to 102 lbs. and averaged 84.2 lbs. Aerolite K with CHW showed failing loads ranging from 70 to 126 lbs., averaging 89.3 lbs.

Medicine

The Effectiveness of Certain Systems of Oxygen Supply. J. K. W. Ferguson. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 486–489, 498, figs. 4 references.



A retractable aileron developed by the Pilotless Plane Division of Fairchild Engine and Airplane Corporation for the U.S. Navy is housed inside the wing and protrudes from the tip when in use.

The investigation was conducted in order to compare the efficiency of the B.L.B. and R.C.A.F. reservoir assemblies, to examine the evidence for "superefficiency" in either, and to obtain more data on the flows of oxygen required with such apparatus. The results are summarized.

Use of the Human Centrifuge in the Indoctrination of a Navy Fighter Squadron in the Use of Antiblackout Equipment. William G. Clark and Ralph L. Christy. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 394–398. 13 references.

The Effect of Amphetamine Sulphate on the Tilt Table Test. Henry W. Newman. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 490–493, figs. 3 references.

A Roentgenographic Study of "Bends" and "Chokes" at Altitude. W. L. Burkhardt, H. Adler, A. F. Thometz, A. J. Atkinson, and A. C. Ivy. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 462–477, illus. 17 references.

Physiological Studies on Man with the Pneumatic Balance Resuscitator, "Burns Model." Hurley L. Motley, Andre Cournand, Morris Eckman, and Dickinson W. Richards, Jr. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 431–461, figs. 19 references.

Reactions of the Human to Impact Forces Revealed by High Speed Motion Picture Technique. Howard R. Bierman and Victor R. Larsen. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 407–412, illus. 5 references.

Mechanical Forces Acting on Aviation Personnel. David E. Goldman. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 426–430. 11 references.

The Effects of Aircraft Accidents upon the Future Performance of Flying Personnel. George M. Hass. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 419–425.

The Management of Surgical Emergencies Following Aircraft Crashes. Edgar C. White and Randolph L. Clark. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 413–418. 4 references.

Some Aspects of Aviation Dentistry. Kermit F. Knudtzon. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 494–497. 9 references.

Medical Aspects of Troop Carrier Aviation. Robert J. Benford. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 478–482, illus. 5 references.

Meteorology

A Simplified Method of Conversion from Thickness Values to Mean Virtual Temperature. Frank L. Martin. *Journal of Aeronautical Meteorology*, Vol. 2, No. 2-3, January–April, 1946, pp. 29–37, illus.

One of the main advantages of the constant level analysis is its ease of application to differential analysis of the atmosphere. This is based on the fact that, assuming the hydrostatic relationship, the geodynamic thickness between two pressure levels is proportional to the mean virtual temperature. The present method of reporting the height of the mandatory pressure levels

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Milliammeters—Volt-Ohmmeters—Wattmeters
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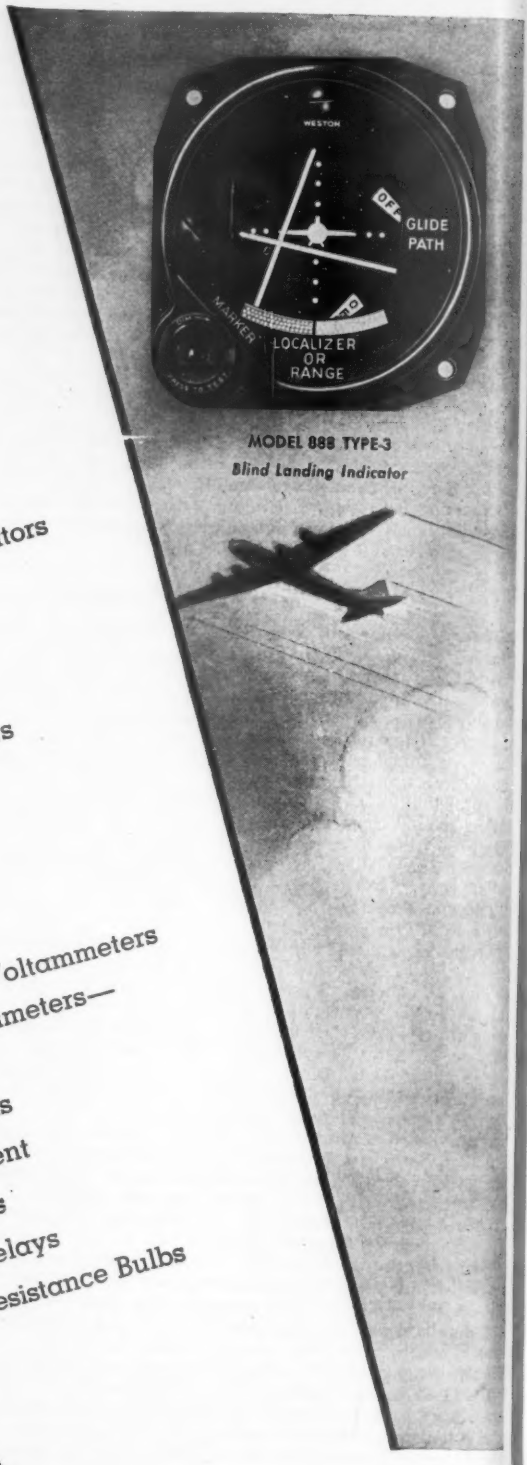

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in geodynamic height makes it important to have a simple system of conversion from thickness between these levels to mean virtual temperature. This paper develops a simple set of straight line graphs all on the same diagram which permit of rapid conversion between thickness and mean virtual temperature. The method is extended to develop an additional set of graphs by means of which rapid pressure-height calculations can be made.

Fog and Low Stratus at the Detroit and LaGuardia Airports. Donald A. Linklater. *Journal of Aeronautical Meteorology*, Vol. 2, No. 2-3, January-April, pp. 46–92, illus.

Two important air terminals, Detroit and LaGuardia Field, are both subject to local weather influences, one owing to its proximity to the Great Lakes, and the other because of its ocean exposure. The prominent meteorological characteristics and topography of the airports are described, with information about the types and causes of fogs, frontal fog forecasting, and air mass forecasting.

AAF Business: Weather. Irving Ripps. *The Log of Navigation and Aviation*, Vol. 4, No. 7, November, 1946, pp. 22–25, 30.

The work and results of a 2,462-mile flight from Castle Field, Calif., to Anchorage, Alaska, made to trace the origin of storms that appear over the Gulf of Alaska.

Finger-Printing the Weather. J. J. George. *The Great Silver Fleet News*, Vol. 10, No. 6, November-December, 1946, pp. 8, 9, illus. The methods of weather forecasting as followed by Eastern Air Lines, Inc.

Military Aviation

The Luftwaffe and Its Failure. Sir Thomas Elmhirst. *Flight*, Vol. 50, No. 1975, October 31, 1946, pp. 478, 479, illus. (Summary of an address.)

The Development of Bombs. Norman Macmillan. *Air Reserve Gazette*, Vol. 1, No. 6, November, 1946, p. 16.

Air Strategy and Atomic War. Norman Macmillan. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 44–51, figs.

Naval Aviation

Deck Landing. James Bridge. *Flight*, Vol. 50, No. 1976, November 7, 1946, pp. 494–496, illus. Details of the operation of aircraft from the flight deck of a carrier.

A Flying Visit to H.M.S. "Illustrious." R. G. Worcester. *The Aeroplane*, Vol. 71, No. 1850, November 8, 1946, pp. 537–540, illus.

A description is given of the background of British naval aviation, of the part played by what is designated as the Trials Carrier in the evolution of air equipment, and of cooperation with other units of the British Navy.

Parachutes

An Automatic Parachute Opening Device. George L. Maison, George A. Hallenbeck, Ralph Sturm, and E. E. Martin. *The Journal of Aviation Medicine*, Vol. 17, No. 5, October, 1946, pp. 399–406, illus. 15 references.

Considerations in the development of automatic parachute-opening devices for Army aviators are outlined. Details are given about a parachute-opening device designed by the Friez Instrument Division of the Bendix Aviation Corporation to the requirements of the Air Matériel Command, which has progressed through three models. Opening of the chute is accomplished by an aneroid-activated squib (explosive cartridge).

Photography

Army K-30 Aerial Camera. *Army Air Forces, Air Matériel Command, Public Relations Office, Release*, November 11, 1946. 2 pp.

What is reported to be the world's largest aerial camera, designed to take large-scale photographs from stratospheric planes at heights up to 10 miles, is undergoing tests by the A.A.F.'s Photographic Laboratory. Designated the K-30, the camera has a 100-in. focal length, f/10 lens, and will provide 9 by 18 in. pictures with two and one-half times more photographic detail from altitudes as high as 10 miles than could be obtained from the largest standard camera used at present. It weighs 575 lbs. By utilizing two mirrors in the camera's optical system to "bend" the light after entering the lens, the design engineers were able to reduce the overall size of the camera to a 4-ft. height and a 5-ft. width. In flight, the camera's shutter, of the focal plane type, will operate in $^1/_{100}$th, $^1/_{200}$th, and $^1/_{400}$th of a second in conjunction with the lens, whose diameter is 10 in. The light enters the lens, is reflected from the first mirror to the second, then to the film, completing the 100-in. light path that forms a figure "4" in a comparatively small, compact area. To combat cold weather conditions at the altitudes at which it will be flown, the camera has been equipped with an interior hot-air circulating system, thermostatically controlled, and a large electrically heated blanket that fits over the entire outside of the camera and lens barrel.

Air Photographs and Archaeology. J. K. St. Joseph. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 76–79, 6 illus. The progress so far achieved in the application of air photography to archaeology is reviewed and possible future developments are suggested.

Air Survey. A. James Payne. *Indian Aviation*, Vol. 30, No. 9, September, 1946, pp. 195, 196, 3 illus.

Brief information is supplied about the O.S.C. Mk.I air camera, produced by the Williamson Manufacturing Company, Ltd., England. Particular attention is given to the design of the hot-air system provided to ensure efficient operation of the camera under extremes in climatic conditions. This takes the form of an air-heated enclosure within which the camera operates. Heat is derived from the cabin-heating system of the airplane.

Production Methods

Why Packard Made New Drawings for the Rolls-Royce "Merlin" Engine. *Product Engineering*, Vol. 17, No. 11, November, 1946, pp. 81–85, illus.

Problems of redesign encountered by the Packard Motor Car Company when it undertook quantity production of the British Rolls-Royce Merlin engine are outlined. The company had to contend with an almost complete absence of international drafting and engineering standards. All the British drawings had to be redrawn because they were in first-angle projection instead of third-angle projection as is customary in American practice. Drawings of subassemblies had to be made by using a finished model of the British engine for guidance. To establish a basis for setting up tolerances, parts of the British engine had to be measured. The problem of duplicating British threads also had to be solved.

Gas Turbine Developments. *The Engineer*, Vol. 182, No. 4738, November 1, 1946, pp. 392–394, illus.

The article describes the equipment of the Wood Top works of Joseph Lucas, Ltd., and production methods used in the manufacture of parts of the combustion system of multichamber jet aircraft engines. Information is supplied about the layout of the plant, the press shop, furnace equipment, and assembly shop. In correcting design weaknesses and establishing the correct workshop technique, metallurgical investigation into the causes of failure was of much assistance. It was found that, in general, failure of combustion can be attributed to one or more of three causes, namely—excessive temperature causing distortion or burning of the metal; fretting of parts under vibration; and

The North American XFJ-1 jet-propelled Navy fighter.

fatigue set up by vibratory stresses, sometimes in combination with the thermal and mechanical stresses. Some examples of early failures are cited.

Bristol Type 167. I. *Aircraft Production*, Vol. 8, No. 11 (97), November, 1946, pp. 514–523, illus. A detailed description of the production methods followed in the construction of the airplane.

Sealing of Porous Castings. Prescott C. Fuller. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 96, 111, illus.

A method for impregnating castings made of low-density metals, such as aluminum and magnesium, is based on the sealing of the microporocitic flaws prevalent in such metals but is not intended to be used for salvaging defective castings. The material, known as Polyplastic MC, is a modified anhydrous copolymer developed by Polyplastex, Inc. One of the basic ingredients is the American Cyanamid Company's thermosetting resin called Laminac, modified to obtain the physical and chemical requirements for making castings pressuretight. The properties of the material are listed and the methods of applying it are described. The methods of impregnation are classified into three groups designated as pressure-vacuum, internal pressure, and vacuum, each of which is outlined briefly.

Precision Forging of High Temperature Alloys. C. H. Smith, Jr. *The Iron Age*, Vol. 158, No. 22, November 28, 1946, pp. 42–46, illus.

New developments in forging technique have made possible the quantity production of precision gas-turbine forgings from high-temperature stainless alloys by the Steel Improvement & Forge Co. The metallurgical and mechanical considerations involved in this precision forging and details of the operation sequence are given. The physical properties of a 16-25-6 alloy turbine wheel and the composition of high-temperature alloys commonly used for forged turbine blades are tabulated.

Design and Production Control of Silver Alloy Brazed Joints in Aircraft Structures. H. A. Smith and P. A. Koerner. *The Welding Journal*, Vol. 25, No. 11, November, 1946, pp. 1061–1067, illus.

An experimental program was initiated by the Beech Aircraft Corporation to determine the extent of the possibilities for using silver brazing methods in the construction of aircraft landing gear. Procedures for establishing the use of brazed joints are described. Information is given about principles of design, principles for making brazed joints, and the certification of aircraft silver-brazing operators.

Profile and Surface Analysis. I. *Aircraft Production*, Vol. 8, No. 11 (97), November, 1946, pp. 509–512, illus.

Part I of a serial article first discusses the advantages of optical projection for the checking of a variety of work and points out certain limitations that must be overcome so that the method may be used to the best advantage for such work as checking of the tooth contour of aircraft gears. Details then are given about a technique developed by D. Napier and Son, Ltd., which retains the basic usefulness of the projector, but largely overcomes its limitations by a combination of mechanical and optical magnification carried out in two stages. Practical applications of the technique are described, as well as the checking of milling-cutter profiles, and templates.

Synthetic Sand in an Aluminum Foundry. William G. Parker. *Aluminum and Magnesium*, Vol. 3, No. 2, November, 1946, pp. 16–18, 24, illus. 4 references.

The importance of a properly prepared sand specimen is demonstrated in a description of the writer's experience in making aircraft aluminum castings. The necessity for a secure and substantial base for the American Foundrymen's Association sand rammer is stressed. Tests conducted in a sand-testing laboratory for the purpose of selecting the most suitable synthetic sand for the casting job are described. The value of proper sand control in the reduction of casting defects is emphasized.

Dimpling Light-Alloy Sheet. *Aircraft Production*, Vol. 8, No. 11 (97), November, 1946, pp. 536–540, illus.

An investigation into the subject of dimpling has been in progress at the University of California since August, 1944. The program was established to study the mechanics of sheet deformation during dimpling, to survey existing techniques, and to develop and evaluate suitable new techniques for dimpling the high-strength alloys. This article deals with the phase of the investigation covering new techniques. The study has been limited to hot dimpling, since previous experience indicated that elevated-temperature dimpling appears to be the most practical method of fulfilling the many requirements for a satisfactory dimple. Consideration is given to methods of heat-treating the sheet before and during dimpling, the equipment used in the experimental development work, and the requirements for basic equipment. Conclusions reached through the investigation are enumerated.

High-Tensile Aluminium Alloy Sheet. J. G. Gwatkin. *Aircraft Production*, Vol. 8, No. 11(97), November, 1946, pp. 527, 528, illus.

In new air-frame designs increasing use is being made of high-tensile aluminum sheet and strip materials requiring a double heat-treatment comprising a solution treatment followed by artificial age hardening. Some typical proof and maximum stresses now being obtained for some of the better-known naturally aging materials by this process are described and compared. Some modifications of the works' routine which were necessary to route these materials through the shops and to ensure their receiving the proper heat-treatment are described.

Some Observations on the Weldability of High-Strength Wrought Aluminum Alloys. William R. Apblett, Jr. *The Welding Journal*, Vol. 25, No. 11, November, 1946, pp. 802s–808s, illus.

The fundamental metallurgy involved in the weldability of high-strength wrought aluminum alloys is discussed. It is indicated from tensile and slow bend tests of welded specimens that the strength of the alloys investigated—61S-T, 24S-T, and 75S-T, is not utilized to the full extent because of both the inadequacy of present-day electrodes and the deleterious effect of welding on wrought aluminum alloys. The tests reported indicate that future investigations should be aimed at the development of an electrode that will produce better mechanical properties in the deposited weld metal and the development of more weldable aluminum alloys.

Spotwelding Technique for Primary Structures. II. Frederick S. Dever. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 64, 65, illus.

The conclusion of a description of procedures followed by The Ryan Aeronautical Company in the spot welding of aircraft primary structures. Important operational factors pertinent to equipment are discussed. Army and Navy weld specifications are outlined. Information is supplied about work-inspection procedures.

Spot Welding Design Data. Frederick S. Dever. *Product Engineering*, Vol. 17, No. 11, November, 1946, pp. 105–109, illus.

Design factors for spot welding as applied to the fabrication of aircraft structures are discussed. The limits for edge distances and for distances between adjacent spot welds, limiting diameters of spot welds, types of spot-welded joints, and the efficiencies of such joints are defined in terms of material thickness. Selected information of general interest to designers about spot welding and the inspection of spot welds is included. Spot-welding operations carried out at a plant of The Ryan Aeronautical Company are used as examples.

Cutting Stainless Steel with the Electric Arc. H. E. Linsley. *The Iron Age*, Vol. 158, No. 20, November 14, 1946, pp. 96–98, illus.

A new technique called Oxyarc cutting, for cutting stainless steel, copper, Monel, and other ferrous and nonferrous alloys, is described. The process involves the use of a tubular mild steel rod through which a stream of oxygen is supplied to the arc. It is stated that the operation is extremely fast and that the parent metal is not contaminated.

Reproducing Drawings on Metal. S. H. Barmasel. *The Iron Age*, Vol. 158, No. 21, November 21, 1946, pp. 62–64, illus.

A description of the Kodak Transfax process, for reproducing engineering drawings, diagrams, and instruction plates on metals, rubber, and plywood.

Induction Heating. *Ohio Crankshaft Co., Tocco Div., Catalog*, 1946. 59 pp., illus.

Contains a study of the theory and application of induction heating in industrial processes. Following a brief review of the origin and development of the process, the principles are explained in semitechnical language. The equipment and controls used are described and the technical considerations governing their application are set forth.

Production Tools and Equipment

Barnes Hydraulic Presses. *John S. Barnes Corp., Release,* Recd. November 6, 1946. 1 p.

An advance in the high-speed handling of sheet-metal fabrication is claimed for two new Barnes hydraulic presses of 25-ton and 50-ton capacities. Designed for the piercing, punching, forming, and drawing of sheet-metal parts, these presses have combined the functions of several presses into one compact machine. Each press is powered by a Barnes self-contained hydraulic unit. Dual electrical controls increase safety and flexibility of operation.

Laminated-Plastic Jigs and Tools. *Aircraft Production,* Vol. 8, No. 11 (97), November, 1946, p. 513, illus.

Two grades of a plastic, Bakelite Laminated, are used for jigs and tools. Not to be regarded as a substitute for metal, they should be well suited for applications where weight must be saved and where the limits of accuracy are in the neighborhood of ±0.005 in.; for example, in drill-and-rout templates for sheet and plate details. The physical properties are listed.

Tantung—What It Is. . .How to Use It. D. I. Brown. *The Iron Age,* Vol. 158, No. 20, November 14, 1946, pp. 76–81, illus.

The metallurgical and physical properties of one of the newer specialized cutting-tool materials developed for the metal-cutting industry are described. Tantung, a nonferrous alloy containing tantalum carbide, is produced by precision casting and can be used to advantage in machining operations. Data from a number of comparative machining tests are reported, together with examples of the use of this alloy for parts where high resistance to corrosion and abrasion is required.

New Abrasive Reduces Grinding Costs. John Anthony. *The Iron Age,* Vol. 158, No. 21, November 21, 1946, pp. 56–59, illus.

A new abrasive of the fused alumina or aluminum-oxide type is identified as 32 Alundum, developed by the Norton Company. It is said to provide more durable abrasive wheels, fewer redressings, faster down feeds, and cooler cutting. The properties of the material are compared with other abrasive materials made by the same manufacturer.

Magnesium-Alloy Dust-Collecting Equipment. *Engineering,* Vol. 162, No. 4218, November 15, 1946, p. 464, illus. A description of the equipment built for Rolls-Royce, Ltd.

Pant-O-Jector Optical Projector. *Engineers Specialties Division of the Universal Engraving & Colorplate Company, Inc., Release,* Recd. November 21, 1946. 14 pp.

The Pant-O-Jector, used for inspecting the blades, buckets, and vanes of gas turbines, is based on the "x" and "y" motion on which a pantograph works, by "tracing the path" of the scribing end of a pantograph on a projection instrument at a known magnification.

Propellers

Airscrew Thrust Grading by Pitot Traverse: Allowance for Rotation of Slipstream at High Rates of Advance. R. C. Pankhurst. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2049,* May, 1945. 12 pp., figs. 2 references. British Information Services, New York. $0.75.

When the thrust grading of a propeller is obtained from measurements of the change in total head across the disc, the simple relationship appears as an equation that may be in error by several per cent, since it neglects the rotational compound of the inflow velocity. An expression is derived for the necessary correction to the thrust grading coefficient, this expression being subject to certain simplified assumptions where the correction factor for rotation of the slipstream is a function of the advance ratio, radius, and number of blades. Tables set forth the correction factor for propellers having two, three, four, five, and six blades.

Integrating Coefficients for Airscrew Analysis. C. N. H. Lock and A. E. Knowler. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2043,* July 14, 1941. 12 pp., tables. 3 references. British Information Services, New York. $0.75.

In calculations of propeller performance by a general graphical method, the value of the thrust grading coefficient or of a power loss coefficient is calculated for a definite series of values of the radius 0.3, 0.45, 0.6, 0.7, 0.8, 0.9, 0.95, 0.975. These values are then plotted against the square of the radius, a smooth curve is drawn, and the area under the curve between the limits 0.09 and 1.0 are determined by the use of a planimeter or by counting squares. It is suggested that the method might be replaced by the use of integrating coefficients. The formulas for these coefficients and the method of deriving them are described. The values adopted are tabulated.

Account of the Derivation of High-Speed Lift and Drag Data for Propeller Blade Sections. R. C. Pankhurst and A. B. Haines. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2020,* August, 1945. 24 pp., figs. 26 references. British Information Services, New York. $1.35.

This report describes the development of the method used for obtaining high-speed lift and drag data of propeller-blade sections. The analyses were based on overall measurements of thrust and torque on full-scale propellers. The method finally adopted for representing the behavior of the lift and drag coefficients of a propeller blade section at high Mach Number is briefly stated.

High-Speed Lift and Drag Data for Propeller Performance Calculations. A. B. Haines and R. J. Monaghan. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2036,* November, 1945. 21 pp., figs., tables. 6 references. British Information Services, New York. $1.20.

The figures and tables of this report provide high-speed lift- and drag-section data for use in the strip theory method of propeller performance calculation. They will have to be extended and possibly modified when further experimental evidence becomes available.

The Elimination of Flutter from a Propeller. L. H. G. Sterne and R. H. Brown. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2047,* February, 1943. 4 pp., figs. British Information Services, New York. $0.30.

Modifications made to the compressed wood blades of a variable pitch propeller resulted in the complete elimination of the flutter that had previously been experienced. The modifications were the removal of the undercamber from the tip sections and the removal of part of the leading edge, so that the sections could be reshaped to conventional Clark form with the greatest thickness at each section distant one-third of the chord from the leading edge. This modification had the effect of bringing the center of pressure farther back relative to the centroids of the inboard sections.

Nitrate Covering for Propeller Blades. Sidney H. Fedan. *Modern Plastics,* Vol. 24, No. 3, November, 1946, pp. 142–145, illus.

The method of applying cellulose nitrate sheeting to the exterior of Aeromatic variable-pitch wooden propeller blades, which has been developed and perfected by the Bartlett Hayward Division of Koppers Company, Inc., is described. The history of the use of a plastic coat on the exterior of wooden propellers to provide maximum resistance to abrasion and moisture absorption is reviewed briefly. The article explains how difficulties encountered in the manufacture on a production basis of propellers with a nitrate covering were overcome. Details are given about the application of the nitrate sheet, and trimming and carving operations.

Photo Courtesy Koppers Company, Inc., Bartlett Hayward Division

Finished nitrate-covered propeller blade is given weight and balance checks by use of scales. (See "Nitrate Covering for Propeller Blades.")

The Problem of Noise Reduction with Reference to Light Airplanes. Theodore Theodorsen and Arthur A. Regier. *U.S., N.A.C.A., Technical Note No. 1145*, August, 1946. 20 pp., figs., tables. 4 references.

Experiments by Deming at the Langley Memorial Aeronautical Laboratory confirm completely the formula of Gutin, which permits the convenient calculation of the sound level of any airplane propeller at low forward speeds. A simplification of the Gutin formula has been achieved by the use of a set of functions giving the sound level in the direction of maximum intensity. The sound level can be read from graphs of the functions for various numbers of blades and tip speeds. Two numerical examples and one experimental example are included and a radical fan-type propeller is tentatively treated. Results of this study show that propeller noise dominates engine exhaust noise even though the exhaust noise has a relatively high intensity. It is concluded that, in order to reduce the outside sound level of an airplane materially, it will be necessary to modify the propeller to operate at low tip speeds and to have a large number of blades. The practical use of this conclusion is a matter of considerable technical complexity involving many compromises. An effective engine exhaust muffler will also be required.

Rotol Developments. *Flight*, Vol. 50, No. 1974, October 24, 1946, pp. 453, 454, illus.

Two developments of Rotol Limited are briefly described, which are designed to contribute to aircraft comfort and safety. One is an automatic device for synchronizing the speed of aircraft engines. The system is based on the selection of one of the engines as a "master," the remaining power units being subject to continuous automatic correction to the governing r.p.m. of the master. The other development is a revision in the normal Rotol deicing system, made to ensure a better distribution of the protective fluid over the propeller blade. The leading edge of each blade has cemented to it a Neoprene synthetic-rubber shoe in the form of a carefully designed tapering strip, grooved throughout its length. At the root of each shoe is an inverted cup or trough, also of Neoprene, into which the feed pipes deliver the deicing fluid. Several holes through the cup direct the fluid into the grooves where it is carried out along the leading edge by centrifugal force and overflows on to the blade.

Automatic Synchronizing Equipment. *The Aeroplane*, Vol. 71, No. 1848, October 25, 1946, p. 471, illus. (Cf. preceding abstract.)

Britain's Airscrews. *The Aeroplane*, Vol. 71, No. 1851, November 15, 1946, pp. 592–594, illus. Brief descriptions and specifications of the propellers of six manufacturers.

Radio

"Weatherproofed" Communications. Lawrence LeKashman. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 56, 168, 171, illus.

A special diversity type RCM radio receiver was developed by engineers of the C.A.A. Signals Division in collaboration with the National Radio Company, to meet the conditions imposed by severe weather in Alaska. The solution of the problem of obtaining weather reports in sequence from a number of isolated stations in spite of static disturbances involved a receiver amounting essentially to an automatic channel selector, each station transmitting simultaneously on several frequencies so that the receiver could select the channel least affected by the disturbances. A typical installation is briefly described and it is suggested that the air lines may be interested in the system.

Maintenance Testing of Automatic Direction Finders. Wayne E. Price and E. M. Hassell. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 78–81, illus.

The design and use of the test equipment. The difficulty of attaining flight conditions in a shielded room was solved by the development of an antenna simulator to reproduce artificially the signal received by a directional loop.

Airadio Aviation Communication Equipment. *Airadio, Inc., Catalog*, Recd. November 21, 1946. 38 pp., illus. General description and operating instructions for the Super "41" receiver and the Super "42" transmitter-receiver, both for use in aircraft.

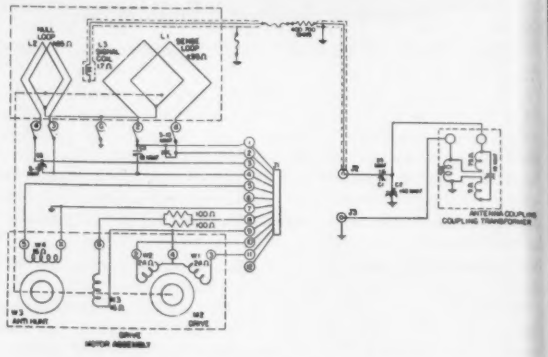

Illustration Courtesy Sperry Gyroscope Company, Inc.

Circuit diagrams of loop simulator which consists of shielded pickup loops rotated in field of exciter coils. (See "Maintenance Testing of Automatic Direction Finders.")

Rotating Wing Aircraft

Jet Propulsion Applied to Helicopter Rotors. R. H. Miller. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, pp. 639–645, diagrs. 3 references.

Some of the factors affecting jet-driven rotor performance are discussed, and it is shown that the relatively high tip speeds required in order to realize a reasonable jet efficiency result in a considerable reduction in the aerodynamic efficiency of the rotor. Although this aerodynamic efficiency may be improved by decreasing the rotor solidity, a practical limit is reached, in the case of jet drives involving airflow through the blades, beyond which the specific fuel consumption increases almost asymptotically with decrease in solidity. However, the weight-saving possible with such drives and their simplicity may in certain cases offset their low aerodynamic and propulsive efficiencies. A rough comparative performance and weight estimate is made between conventional and jet-driven helicopters in an attempt to evaluate their relative merits.

An Investigation of the Airflow Underneath Helicopter Rotors. Robert S. Ross. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, pp. 665–677, illus. 3 references.

The airflow underneath helicopter rotors, as determined by the classical blade-element and momentum theories without the assumptions of constant chord or constant circulation along the span, was estimated from theoretically determined charts. These values were compared with those obtained from the actual measurements taken near a model rotor with a "hot wire" anemometer. Both time average and instantaneous readings of velocity were taken at simulated hovering and horizontal flight conditions. These measurements showed the theoretic estimation to be good at low angles of attack and at positions not too near the blade tips. They also indicated the pulsations that occur in horizontal flight and showed these to be of unanticipated magnitude. Positions of maximum and minimum effect were tested to get the range of pulsation. This method of determining rotor characteristics was different from those now employed, and the equipment used was built specially for these tests. The instruments were easy to handle and offered an improved picture of the distribution of rotor forces.

Helicopter Power Requirements. C. Peyton Autry. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, pp. 337–342, illus.

An investigation is made of the efficiency of the helicopter rotor system, that is, the minimum power required for a given performance. The study is intended to indicate the effects of gross weight, rotor diameter, rotor r.p.m., blade solidity, and hovering altitude on the power required compared with the performance required. The general approach to the problem is to find the minimum power required for any aircraft by a rather wide variation in the stipulated determining factors. Optimum rotors and rotor speeds are given.

Practical Engineering of Rotary Wing Aircraft. V. John E. McDonald. *Aviation*, Vol. 45, No. 11, November, 1946, pp. 62, 63, illus.

The Chief Engineer of the Autogiro Company of America continues a discussion of design criteria for rotary wing aircraft. A

Bell Aircraft Corporation's two helicopter production lines. In the foreground are Model 47's heading for the commercial market. The second line consists of rotary wing aircraft scheduled for delivery to the Army Air Forces, the Army Ground Forces, and the Navy.

brief history of the manifestations of vibration is presented. The phenomena are classified and a flapping equation for a single rotor blade is developed.

Low-Density Rotor Blades. George P. Martin. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 91, 121, illus.

Following an outline of six possible improvements that could be incorporated in rotor blades to meet the requirements imposed by use in helicopter rotors, the writer reviews the construction and performance of special blades designed and built by the Universal Helicopter Corporation for the Rotary Wing Section of the Air Matériel Command for use on the R-6A helicopter. The materials selected, the methods of fabrication, and the results of tests conducted at Wright Field are noted.

U.S.S.R. Rotating-Wing Aircraft. *The Aeroplane Spotter*, Vol. 7, No. 175, November 16, 1946, p. 268, illus. Descriptions of the principal types.

Sikorsky Unveils New Helicopter. *Aviation News*, Vol. 6, No. 22, November 25, 1946, p. 12, illus.

The Sikorsky S-52 two-place helicopter is intended particularly for military liaison and patrol work. Designed for a maximum speed of 105 m.p.h. and a useful load of 650 lbs., it is provided with all-metal rotor blades as standard equipment.

Rotary Wing Kite. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 86, 87, illus. (Cf. AER 10/46:65.)

McDonnell's Large Helicopter. *Aero Digest*, Vol. 53, No. 5, November, 1946, pp. 87, 170, illus. (Cf. AER 10/46:63.)

A Rotating Wing Enterprise. R. A. Pullin. *Aeronautics*, Vol. 15, No. 4, November, 1946, pp. 117, 118, 121, 123, diagrs. The development of rotating wing aircraft, with particular reference to the activities of the Cierva Autogiro Company, Ltd., and its licensees.

Helicopters As a Means of Transportation. IV. Raoul Hafner. *American Helicopter*, Vol. 5, No. 1, December, 1946, pp. 10, 11, 37, 47, diagrs.

Competition with existing forms of transport is discussed. The analysis is based on certain assumptions regarding costs, speeds, time saving, etc., derived from definitions that apply to any form of transportation.

Pacific Venture. John J. Sanduski. *American Helicopter*, Vol. 5, No. 1, December, 1946, pp. 12, 13, 38–41, illus. A popular account of helicopter operations in air-sea rescue.

St. Martin in the Woods. Joe Martin. *American Helicopter*, Vol. 5, No. 1, December, 1946, pp. 8, 9, 35, 36, illus. Recital of the work performed by a Coast Guard helicopter in the rescue of the passengers and crew of a transport airplane wrecked in Newfoundland.

Stress Analysis and Structures

The Stress in a Circular Fuselage. W. J. Goodey. *The Royal Aeronautical Society, Journal*, Vol. 50, No. 431, November, 1946, pp. 833–871, illus.

Investigations were made primarily in order to determine the manner of transmission of concentrated loads from the frames to the skin of a circular fuselage. The more fundamental approach to the subject was made because the usual assumption, that the shear distribution in the skin adjacent to the frame is given by the simple "beam theory," was considered to be of doubtful validity, and the writer suspected that a critical examination of the problem would show a considerable variation from the ordinary theory in the immediate vicinity of the loaded frame. The investigation shows that the bending moment distribution in a frame subjected to a concentrated load differed considerably from that given by ordinary beam theory, the difference depending on the flexibility of the frame. It further shows that even greater departure from beam theory can occur in the stress distribution in the skin of the fuselage, and that bending stresses in the skin and stringers near the loaded frame may be several times their beam-theory values. Such stresses may therefore be as important as those at some distance from the frame, where the stress distribution has settled down to the beam-theory distribution.

The Column Paradox. F. R. Shanley. *Journal of the Aeronautical Sciences*, Vol. 13, No. 12, December, 1946, p. 678. Reference.

In a short article the "reduced modulus" theory for computing column action in the inelastic range is explained and compared with the use of Young's modulus and the tangent modulus. A question is raised with regard to the assumption implied in the derivation of the reduced modulus theory by which it is, in effect, assumed that something keeps the column straight while the strain increases from that predicted by the tangent modulus theory to the higher value derived from the reduced modulus theory. The paradox represented by the assumptions involved is discussed, and it is concluded that to find the maximum load for a perfect column in the plastic range, it will evidently be

Gleam in the Eye of a Navy Cadet

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necessary to analyze each case separately, using a step-by-step process and employing the general methods followed by von Kármán in his solution of the eccentric column.

Effect of Small Deviations from Flatness on Effective Width and Buckling of Plates in Compression. Pai C. Hu, Eugene E. Lundquist, and S. B. Batdorf. *U.S., N.A.C.A., Technical Note No. 1124*, September, 1946. 41 pp., figs. 13 references.

A theoretic investigation was undertaken to evaluate the effect of small deviations from flatness on the behavior of simply supported square plates under compression, it being assumed that the proportional limit is not exceeded. This study involved the solution of the von Kármán large-deflection equations according to the method used by Samuel Levy in *N.A.C.A. Technical Note No. 846*. As a result of the investigation, it was found that: (1) The effects of initial deviations from flatness upon buckle growth and effective width of plate are most marked at stresses around the theoretic flat-plate critical stress; at stresses well above or below the critical stress, the behavior of a plate with an initial deviation from flatness is much the same as that of an initially perfectly flat plate. (2) In two commonly used laboratory methods giving experimental critical stresses related to the start of rapidly increasing lateral deflections it may be expected that the larger the initial deviation from flatness the smaller is the experimental critical stress. (3) The Southwell plot method of predicting theoretic critical stresses for perfect specimens from experimental observations on actual specimens may not be expected to give, in general, satisfactory results when applied to flat plates.

Stress Diffusion Problems. V. W. J. Goodey. *Aircraft Engineering*, Vol. 18, No. 212, October, 1946, pp. 343–346, illus.

The writer considers the state of stress in the top skin and in the rear spar of a simplified two-spar wing having an outer portion skin-covered and an inner open portion, the two spars being built in at the inner end. It is noted that the top and bottom skins will usually be reinforced with spanwise stiffeners and the application of torque to the box will induce end loads in these stiffeners, in addition to bending moments in the spars. These end loads are essentially a local effect, localized near the inner end of the skin-covered portion of the wing, and at sections remote from the inner end the torsional stresses in the box will be given by the ordinary Batho formula. At the inner end of the skin covering, the front and rear spars will have equal and opposite bending moments in them. The state of the stress in the box due to the equal opposite bending moments applied to the spars at the inner end, the applied torque being zero, is investigated. The effects of the applied torque are then superimposed to obtain the complete solution of the problem.

The Brittle Lacquer Method for Estimating Stress Distribution in Welded and Riveted Joints. R. F. Tylecote. *Sheet Metal Industries*, Vol. 23, No. 235, November, 1946, pp. 2194–2198, illus.

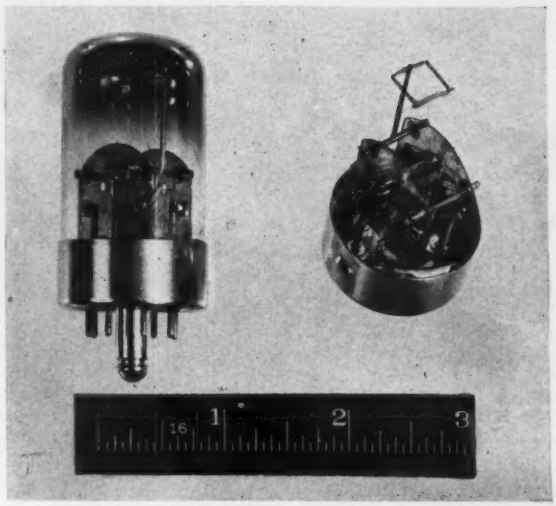
A special lacquer is applied to the specimens, which are then gradually loaded until strain lines develop in the lacquer. An investigation of the stresses in welded and riveted joints of aircraft structures using the brittle-lacquer method is described.

Strain Gauging in Structural Design. H. E. J. Rochefort. *The Aeroplane*, Vol. 71, No. 1848, October 25, 1946, pp. 474–478, illus.

The principles on which the strain gage operates, as well as the measuring instruments used for computing changes of resistance by means of the Wheatstone bridge method, are described briefly. Strain-gage technique has been found valuable in structural problems involved in aircraft design. Some observations are made regarding the application of the system in the development of fighter aircraft. Different methods of recording are compared. Emphasis is placed on the importance of properly positioning the gages on the specimen.

Effect of Misalinement of Strain-Gage Components of Strain Rosettes. S. S. Manson and W. C. Morgan. *U.S., N.A.C.A., Technical Note No. 1133*, September, 1946. 20 pp., figs. 8 references.

A mathematical analysis was made of the effect of misalignments among the components of rectangular and equiangular strain rosettes on the determination of the magnitudes and directions of principal strains. Misalignments of $\pm 2°$ among individual gages introduce no serious errors in the computation of principal strains from rosette data. Errors caused by a given misalignment are proportional to the maximum shear strain at the test point and the effect is most important in regions of pure shear. The equations derived in the analytic investigation provide corrections that are applicable only if the misalignments are known. These equations indicate qualitatively the limits of accuracy with which strain determinations can be made when the possibility of misalignment exists. Verification of the analysis was made by experimental investigation of the behavior of a rosette the misalignment of which was known.



The vacuum tube acceleration pickup as developed by the National Bureau of Standards. The tube consists of a fixed, indirectly heated cathode with elastically mounted plates, one on either side, as shown in the view at the right. (See "Vacuum Tube Acceleration Pickup.")

Wind Tunnels and Laboratories

Blockage Corrections in a Closed High-Speed Tunnel. A. Thom. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2033*, November, 1943. 24 pp., figs. 3 references. British Information Services, New York. $1.35.

The corrections that have to be applied to measurements in a tunnel due to the solidity of the body experimented on and due to its wake are called "solid blockage" and "wake blockage." A method of allowing for the effect of the wake is suggested and discussed. The application to the case of speeds approaching the velocity of sound is discussed with special reference to the Royal Aircraft Establishment high-speed tunnel. The subject matter has been written for direct application to that particular tunnel but many of the formulas are of general applicability. It appears that these corrections become extremely large for Mach Numbers of the order of 0.8 to 0.85.

Navy Rebuilding German Test Tunnels for Experiments in Supersonic Speeds. *Engineering News-Record*, Vol. 137, No. 17, October 24, 1946, p. 8 (550), illus.

Three German supersonic wind tunnels stated to be of a design unique to the United States and believed by the Navy to be superior to other known types have been brought to this country and are being installed in a new building at the U.S. Naval Ordnance Laboratory at White Oak, Md. A striking feature of the tunnel design, in which measurements for the V-2 rocket were made throughout the entire range of supersonic speeds up to Mach Number 4.4, is the method of intermittent operation of the two large tunnels, requiring only a fraction of the power needed for a continuous tunnel of comparable size. A large sphere and a discharge valve containing a second throat and a quick-opening valve known as a Polte valve are the heart of the intermittent system. Another feature is the flexibility of the test-section construction, permitting instant access to the models and the instrumentation from above, below, or either side. The construction and operation of the intermittent and continuous tunnels are described briefly.

Research Laboratories of the Ethyl Corporation. *Ethyl Corporation, Research Laboratories*, 1946. 32 pp., illus. A description of laboratories concerned with the development and perfection of engine fuels, lubricants, and additives for gasoline and oils.

Drop-wire undergoing abrasion tests in birch thicket "laboratory." Below, the new drop-wire, now being installed.

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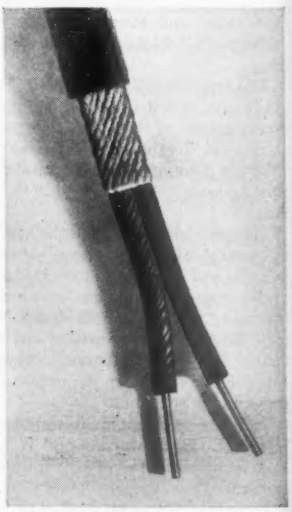
The telephone wire which runs from the pole in the street to your house is your vital link with the Bell System. More than 17,000,000 such wires are in use.

The wire becomes coated with ice; it is ripped by gales, baked by sun, tugged at by small boys' kite strings. Yet Bell Laboratories research on every material that goes into a drop-wire—metals, rubbers, cottons, chemicals—keeps it strong, cheap, and ready to face all weathers.

Now a new drop-wire has been developed by the Laboratories which lasts even longer and will give even better service. It has met many tests, over 6 or 7 years, in the laboratory and in field experiments. It has been strung through birch thickets—rubbed, winters and summers, against trees, and blown to and fro by winds. In such tests its tough cover lasts twice as long as that of previous wires.

House by house, country-wide, the new wire is going into use. Wire is only one of millions of parts in the Bell System. All are constantly under study by Bell Telephone Laboratories, the largest industrial laboratory in the world, to improve your telephone service.



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Books

All of the books reviewed and listed are in the I.A.S. Library and may be borrowed without charge, except for certain reference books. Application for loans should be made to The Paul Kollsman Lending Library, 2 East 64th Street, New York 21, N.Y.

Flight Testing: Conventional and Jet-Propelled Airplanes. Benson Hamlin. New York, The Macmillan Co., 1946. 147 pp., illus. $5.00.

In recent years the principal general works of any size on flight testing have been published in England. Material on the subject has been available in technical journals and reports but not in an American reference manual of the authority and detail of this one, which grew out of a lecture training course for engineers given by the author at Bell Aircraft Corporation. It presents practical flight-testing techniques, procedures, and methods of interpretation of flight-test data in use in various industrial and governmental organizations conducting airplane research. Following a brief treatment of the general order of experimental flight testing, basic measurements, and Bernoulli's equation, the tests for conventional airplanes are taken up systematically. The purpose and definition of the test, the basic theory, analytic procedure, data, reduction, and data required are discussed. This section includes air-speed and altimeter position error calibration, free air temperature calibration, stalling speed, critical altitude, maximum speed determination, climb performances, take-off and landing distances, range and endurance, and stability and control. Determination of Mach Number, engine and power characteristics, and universal speed-power polar are covered in other sections.

The final seven chapters dealing with the flight-testing of jet-propelled airplanes are the first generally available treatment of the subject. Turbojet engine characteristics, the concept of thrust and drag, glide polars, maximum speed determination, climb performance, take-off and landing, and range and endurance are discussed. The book ends with a flight-test report outline and a list of 31 references. A useful work for the flight-test engineer, the engineering test pilot, and the engineering college student, as well as others concerned with the interpretation of flight-test data.

Cargo Aircraft. W. W. Davies. New York, Pitman Publishing Corp., 1946. 216 pp., illus., diagrs. $6.00.

The first book to collect the scattered technical material on the subject presents a timely and well-done technical study of the problems of cargo aircraft design and operation. Following a brief survey of early development, cargo aircraft for the immediate future are discussed. The air-cargo market and the characteristics of air cargo complete the first quarter of the book. The fundamental considerations of cargo-plane design, detail considerations in air-frame design, and detail considerations in equipment design are next taken up. The book concludes with chapters on loading methods and equipment, handling and stowage methods and equipment, and the air tramp and charter plane. Appendixes include data on requirements for a combination cargo-passenger craft, cargo flow, development of cost formulas, aircraft and component original cost values, general characteristics of cargo airplanes, ground-loading equipment costs, and outline drawings of representative air cargoliners. There is a good index.

It should be emphasized that the treatment of topics is specific rather than general and is clearly illustrated by tables, charts, and photographs. The book should prove to be an indispensable work of reference.

Explosion and Combustion Processes in Gases. Wilhelm Jost. Translated by Huber O. Croft. New York, McGraw-Hill Book Co., Inc., 1946. 621 pp., illus., diagrs. $7.50.

Because of the importance of Dr. Jost's theories of the application of physical chemistry to the development of the basic theories of combustion, this translation was undertaken. Experiments are described in such detail that conclusions may be drawn independently of the author's theories, especially in the well-defined fields of research. In fields less clearly defined, the experiments of various scientists are treated individually and the effort is made not to have theoretic considerations cause certain data to be stressed at the expense of others. The initial stages of explosions, propagation of explosions, detonation of kinetics of combustion and explosion processes, combustion of oxygen-hydrogen mixtures and carbon monoxide, the combustion of hydrocarbons, and combustion in Otto engines comprise the major portion of the book. Other chapters deal with the thermal theory of spark ignition, explosions in closed chambers, flames of gases not premixed, flame temperatures, spark ignition (reaction in electrical discharges), and explosions in Diesel engines. References to sources are numerous and there is a bibliography of the principal books on combustion.

This is one of the publisher's series of "Publications in Aeronautical Science," of which Dr. Jerome C. Hunsaker is consulting editor. The original work was published in Germany in 1939. The translation was undertaken at the suggestion of Dr. W. F. Durand and Dean Edward L. Moreland.

Commercial Air Transportation. John H. Frederick. Chicago, Richard D. Irwin, Inc., 1946. 791 pp., illus. $5.00.

The new edition of this textbook reflects the changes that have taken place since the appearance of the first edition early in 1942 and, to some extent, the state of publishing in relation to the engineering phase of air transportation. Approximately 300 pages larger than the old one, this edition includes added chapters on the adequacy of air-line development, nonscheduled air transport, rates, business practices, and federal or state regulation and taxation.

A new section on air-line operations covers the organization of an air-line, station administration and flight control, flight procedures and communications, maintenance, selling air travel, passenger handling, and ticketing, selling air-cargo transportation, air-cargo handling, and air-line public relations. Although it does not replace Blomquist's *Outlines of Air Transport Practice* (1940), this section is more up to date and its inclusion indicates the need for more technical books by engineers on air-transport operations and books by operating people on air-line management. The author has done a service for teachers and students by adding this section.

This edition has many additional tables and illustrations, and the book has been almost entirely rewritten. Air transportation in Alaska and Canada is covered in two new appendixes. Another new appendix deals with air-line employment possibilities, job de-

scriptions, and salary ranges. References are made to sources and an up-to-date bibliography is included.

Principles of Radar. Members of the Staff of the Radar School, Massachusetts Institute of Technology. 2nd Ed. New York, McGraw-Hill Book Co., Inc., 1946. 909 pp., illus. $5.00. (Reproduced from typewritten copy.)

This is the first generally available textbook on radar. The earlier edition of 1944 was not widely distributed for reasons of military security. Following a brief description of the components and functions of radar systems, typical system components are examined in detail. The exposition is done with technical thoroughness and accuracy, with minimum dependence upon mathematics. Emphasis in the treatment of circuits is upon quantitative analysis directly from tube characteristics and physical principles. The chapters on timing circuits, indicators, modulators, transmit-receive devices, and synchros and servomechanisms have been completely rewritten. The section on automatic frequency control in the chapter on receivers has been revised and expanded, and the section on impedance matching in the chapter on radio-frequency lines rewritten. The subject of propagation has been added as part of the chapter on radar antennas and propagation.

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SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

The Navy's Air War; a Mission Completed. U.S. Navy. The Aviation History Unit. Edited by A. R. Buchanan, with a foreword by Admiral Marc A. Mitscher. New York, Harper & Bros., 1946. 432 pp., illus. $3.50.

Making no pretensions to being a critical or professional analysis of operations and performance, this book summarizes the general achievements of naval aviation in the war.

In the Atlantic the early neutrality patrol and its convoy gave way in 1941 to antisubmarine warfare. Operations were next extended to the South Atlantic with the creation of bases in South America. Finally, amphibious operations, gunfire support, and the use of escort carriers became important in the Italian and French invasions. The Coast Guard's use of helicopters and the Air-Sea Rescue Service are included in the summary of Atlantic Theater operations.

In the Pacific Theater there is first the story of a courageous record against overwhelming odds in the Philippines. In the Battle of the Coral Sea aircraft carriers played the principal part for the first time. Midway set the pattern for future naval warfare, and in the Guadalcanal campaign carrier groups were used as temporary land-based groups. The operations in the Western Carolines saw the first use of a fully equipped night carrier, and in the retaking of the Philippines, the support of ground troops. The story of the largest amphibious operation ever undertaken in the Pacific is told in the section on Okinawa.

The importance of the forces behind the air war is described in Part V, and includes a survey of training, the importance of synthetic training devices, the problem of increased production, the expansion of shore establishments, the vital role of maintenance, and the work of the Naval Air Transport Service. The part played by developments in electronics, photographic intelligence, weapons, and aviation medicine is especially interesting. A 24-page chronology is included. Readability is successfully combined in the book with the factual accuracy to be expected of an officially sponsored history.

An Index of Mathematical Tables. A. Fletcher, J. C. P. Millar, and L. Rosenhead. New York, McGraw-Hill Book Co., Inc., 1946. 450 pp. $16.

By providing an index to more than 2,000 published and some unpublished mathematical tables, this compilation will fulfill a dual purpose. For users of mathematical tables it will provide as complete a record of the subject as possible, and to makers of such tables it will show what has already been done in the field and thus help to avoid duplication. The authors hope also that the index will show clearly which tables of functions are at present inadequate or entirely lacking, and so stimulate work in the direction of filling main gaps. Part I, an index according to functions, is divided into 24 sections, each devoted to tables of a particular group of functions, and

each group is minutely subdivided. Each item gives from left to right: number of decimals or figures, interval and range of argument, a symbol showing facilities for interpolation, and authorship and date of the original table indexed. The introductions to the sections explain with exceptional clarity the entries that follow, giving details concerning the indexed tables, explanations of diversity of notation, and cross references to similar tables. Part II is a complete list of the published material referred to in Part I, arranged alphabetically according to author. It is followed by a subject index to Part I.

The Brereton Diaries. The War in the Air in the Pacific, Middle East and Europe, 3 October 1941–8 May 1945. Lewis H. Brereton. New York, William Morrow and Co., 1946. 450 pp. $4.00.

General Brereton fought in a defensive war in the Philippines, Java, Australia, and China-Burma-India up to June, 1942. He was called to North Africa to form the Middle East Air Force and was present when General Auchinleck ordered a counterattack at El Alamein on July 4, 1942, the first time he had seen the offensive taken. When the Ninth Air Force was moved to England, General Brereton was assigned the job of forming it into a tactical air force, which he commanded until August 7, 1944, when he was chosen to command the First Allied Airborne Army. A close-up of the air war by one who knew it thoroughly, this book is more than a diary. The index of persons contains nearly 300 names, from Mitchell, Arnold, Churchill, and Eisenhower, to various lieutenants, sergeants, and privates, all of whom are vividly projected in the book. The author's interpretations will be valuable also to historians.

The Aircraft Manufacturing Industry, Present and Future Prospects. George Bryant Woods. New York, White, Weld & Co., 1946. 119 pp., tables. $5.00.

This study is designed as a reference book for investors in aircraft securities. The prospects for the industry as a whole are appraised in the first section, including reviews of accomplishments, 1940–1945, reconversion, effects of the war, variety of aircraft in the future, and the outlook for private, commercial, and military aircraft. General prospects for aircraft manufacturing company stocks are appraised in the second section. The final part examines the outlook for 13 large companies, 21 smaller companies, small private-plane manufacturers, small engine manufacturers, and helicopter manufacturers. Although concerned primarily with financial aspects, the book is a useful summary of the present and future status of the aircraft manufacturing industry.

Aircraft Woodwork. Rollen H. Drake. New York, The Macmillan Co., 1946. 197 pp., illus. $3.50.

To fill the need for a single volume in nontechnical language covering all phases of aircraft woodwork, this book is offered for use as a mechanic's manual or as a textbook in the classroom and shop. The author states that the text is designed to cover approximately one year's work in a standard vocational curriculum. Information is given on the characteristics, identification, and uses of aircraft woods. Detailed instruction is presented in the technique of selection, with explanations and illustrations of various grain and other possible defects. Following a glossary of terms, there are chapters on reading technical drawings, working with and applying glues, and making joints. Tools are covered by means of illustrations, and the technique of doping and finishing is explained. Other chapters deal with the construction of aircraft sections, such as the root bay of a fabric-covered wing, plywood-covered vertical fin, and plywood-covered fuselage. Repairs to fabric, plywood, wing-structure, and fuselage are treated. The volume is one of "Drake's Aircraft Mechanic Series."

Plastics Molds, Design, Construction, Use. Gordon B. Thayer. 3rd Ed. Cleveland, Huebner Publications, 1946. 272 pp., illus. $5.00.

The fundamentals of plastic mold design are brought up to date and applied to representative type molds in this new edition. Various materials used for plastic molds are considered and the designs of different types of molds are each presented in detail. Building methods and equipment, methods of mold sinking, and finishing are described, together with explanations of ejector systems. Molding screw threads and plastic tooling are also discussed, and detailed instructions and tables are given for estimating man-hours, costs, and operations. The work is clearly written and illustrated with excellent photographs and drawings.

Other Books Received

AIR TRANSPORT

Air Transportation . . . Little Known Facts. 8th edition. Washington, Air Transport Association of America, 1945. 31 pp., illus., diagrs. Statistical data presented in tables and graphs.

British Air Transport. (*British Survey*, v. 5, nos. 12, 13, April 27, 1944.) London, British Society for International Understanding, 1944. Pp. 63–71. 6*s*. The past and future of British air transport.

Civil Aviation in Canada, 1945. Ottawa, Dominion Bureau of Statistics, 1946. 8 pp., tables. $0.10. Reproduced from typewritten copy.

Transport Coordination in the United States. P. Harvey Middleton. Chicago, Railway Business Association, 1946. 72 pp., fold. maps. The emphasis is upon rail-highway coordination, with brief mentions of air transport.

AIRPLANE USES

Aeroprospecting in the Yellowknife area. A. W. Jaliffe. (Reprinted from Canadian Institute of Mining and Metallurgy. *Transactions*, v. 68, 1945, pp. 588–609.) Montreal, 1945. Illus.

AIRPORTS

Airport Accounts. Joseph M. Cunningham. Chicago, Municipal Finance Officers Association, 1945. 28 pp. $1.25. A standard system is proposed which is applicable to both commercial and governmental operations, using a numbered classification accompanied by a detailed explanation of each item of the classification.

Decker's Airport Guide. Fairfield, Conn., Decker Air Services, Inc., 1946. 5 v. $1.25 each. Brief descriptions are given, with information on services and accommodations, of the airports in the Pacific, North Central, South Central, North Atlantic, and South Atlantic zones.

Fundamental Considerations in Designing Airports. William E. Cullinan. **Methods and Equipment Used in Building Rigid and Flexible Airfield Pavements.** Burton J. Bell. (Technical Bulletin No. 102.) Chicago, American Road Builders' Association, 1946. 24 pp., illus.

Guide to Civil Land Aerodrome Lighting. (British Standard 1332.) London, British Standards Institution, 1946. 16 pp. 2*s*. A description of probable future requirements of airport lighting equipment, subject to possible changes under international agreements.

ATOMIC ENERGY

The Atomic Bomb, compiled by Julia E. Johnsen. (The Reference Shelf, v. 19, no. 2.) New York, The H. W. Wilson Co., 1946. 335 pp. $1.25. A compilation of comments by various authors on the history and development of the atomic bomb, social and other implications of atomic theory, national and international control and peacetime benefits of the atomic age. A bibliography of more than 800 items is included.

Atomic Energy in Cosmic and Human Life. George Gamow. New York, The Macmillan Co., 1946. 161 pp., illus., diagrs. $3.00. The development of experimental work on atomic energy and radioactivity is described in nontechnical language. Professor Gamow's own work on the theory of atomic nuclei has contributed to this development. His ability to write understandable scientific books for the layman is again demonstrated in this book.

Hiroshima. John Hersey. New York, Alfred A. Knopf, 1946. 118 pp. $1.75. This is the complete text of this classic report of the effect of the first atomic bomb upon the lives of six Japanese.

The Effects of the Atomic Bombs at Hiroshima and Nagasaki. Report of the British Mission to Japan. London, His Majesty's Stationery Office, 1946. 21 pp., illus. 1*s*. An official overall report of the social and physical effects of the atomic bombs.

Must Destruction Be Our Destiny? Harrison Brown. New York, Simon and Schuster, 1946. 158 pp. $2.00. The author has been engaged in atomic research on the Manhattan Project, partly at Oak Ridge, and now at the University of Chicago. His statement of the problem is authoritative and his proposed solution of control by a world agency is stated with exceptional clarity.

Scientific and Technical Aspects of the Control of Atomic Energy. United Nations. Atomic Energy Commission. New York, United Nations, Department of Public Information, 1946. 42 pp., diagrs. $0.25. The first report of the Scientific and Technical Committee of the Atomic Energy Commission, with a glossary of scientific terms and biographic notes.

Symposium on Atomic Energy and Its Implications. (American Philosophical Society, *Proceedings*, v. 90, no. 1.) Philadelphia, 1946. 79 pp. $1.00. Twelve papers read at a joint meeting with the National Academy of Sciences in November, 1945.

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Why Smash Atoms? Revised edition. Arthur K. Solomon. Cambridge, Harvard University Press, 1946. 204 pp., illus., diagrs. $3.00. Material from the Smyth report and other sources has been used to add three new chapters to this new edition. In language written for the layman, Dr. Solomon traces the ideas and discoveries that have contributed to developments of the last 50 years in atomic research, then describes methods of disintegrating the atom and various instruments that are used in examining nuclear reactions. He concludes with a discussion of the relationship of atomic research to other fields, and the atomic bomb.

BUSINESS AND FINANCE

Survey of American Listed Corporations: Data on Profits and Operations, 1944–1945. Washington, U.S. Securities and Exchange Commission, 1946. 168 pp., tables. Reproduced from typewritten copy.

EDUCATION AND TRAINING

Preparation and Use of Visual Aids. Kenneth B. Haas and Harry Q. Packer. New York, Prentice-Hall, Inc., 1946. 224 pp., illus. $4.00. This is a timely and well-planned outline of practice in obtaining and using films, film strips, pictures, posters, and other visual material, and the equipment for use with it. It should be useful to those engaged in teaching at all levels, personnel training, sales demonstrations, displays, and advertising.

The Royal Air Force School for Prisoners of War. Stalag Luft VI. London, British Red Cross Society and the Order of St. John of Jerusalem, January, 1945. 16 pp. 2*s*. A facsimile of a manuscript illuminated by James W. Lambert, an R.A.F. sergeant in a prisoner of war camp, describing a typical school formed by British prisoners of war through the cooperation of the Red Cross Educational Section.

The Story of the Air Training Corps. London, Air League of the British Empire, 1946. 66 pp., illus. 3*s*. The activities and history of the Air Training Corps, founded early in 1941 as an official continuation of the Air Defence Cadet Corps.

World Congress on Air-Age Education, New York, 1946. Proceedings and Abstracts of Speeches. New York, Air-Age Education Research, 1946. 115 pp., illus. $1.00. Summaries of committee reports and speeches at this Congress, which was attended by 350 members from 22 countries.

ENGINES

Aircraft Engine Mechanic's Study Guide. Los Angeles, Calif., Aero Publishers, 1946. 176 pp., diagrs. $2.75. A useful compilation of data, with questions and answers, for use as a study guide for examinations for the C.A.A. Aircraft Engine Mechanics Certificate. Selected parts of C.A.A. and War Department publications have been combined with the questions.

FICTION AND JUVENILE

Airport Summer. Eileen Wood. New York, Henry Holt & Co., 1946. 190 pp., illus. $2.00. A children's story centering around the actual workings of an airport.

The Flight Brothers. Mrs. L. R. S. Henderson. Chicago, The Reilly and Britton Co., 1912. 102 pp., illus. A children's story.

Flying with the Air-Sea Rescue Service. Lewis E. Theiss. Boston, W. A. Wilde Co., 1946. 291 pp., illus. $2.25. A novel of the adventures of two young men in the International Air-Sea Rescue Service, notable for its technical accuracy and for the information it contains about the air-sea rescue work.

The Quest of the Golden Condor. Clayton Knight. New York, Alfred A. Knopf, 1946. 346 pp., illus. $2.50. A story for older boys, describing the quest by an archaeologist and his two sons for a golden image of a condor in Peru, illustrated by the author. The flying episodes are written with authority.

Valiant Youth, the Men of the R.A.A.F. J. C. Waters. Sydney, Australia, F. H. Johnston Publishing Co., 1945. 103 pp., illus. 12*s*. 6*d*. Twenty-one vivid stories of Royal Australian Air Force pilots in action against Japs and Germans.

First to Fly; from Roger Bacon to Sir Charles Kingsford Smith. Stanley Brogden. Melbourne, Whitcombe & Tombs Pty., Ltd. 166 pp., illus. 7*s*. 6*d*. A brief account of some of the pioneers and feats of aviation history, written in popular style for young people.

Flight into Danger, by Frank W. Mason; J. B. Lippincott Company, New York, 1946; 174 pages, $1.75.

When Gen. H. H. Arnold was a major he devoted his spare time to writing books for boys which remain interesting and authentic even today for the factual information they contain. Colonel Mason, author of other books about air and naval exploits, has written a story about the wartime advent ures of a daredevil pilot.

Flying heroes, secret agents, and intelligence officers play their roles when the pilot captain, after almost overstaying his leave on the Riviera, is given an opportunity to regain the confidence of his superiors by a secret mission into occupied France.

Red Rain, by Leslie Kark; The Macmillan Company, New York, 1946; 254 pages, $2.50.

The private lives of a British bomber crew are the author's concern. He follows their early experiences, leading up to the fatal ending on a raid over Germany. It is a novel written by a Wing Commander who knows, through experience, the emotional strain undergone by those taking part in dangerous raids. The disillusionment of those who held idealistic views of the objectives to be gained by fighting is emphasized by the experiences of the one man who escapes from the burning bomber.

Sky Road to Adventure, by Lewis E. Theiss W. A. Wilde Company, Boston, 1945; 303 pages, $2.00.

In this story four young airmen, Air Transport Command pilots, were ordered to China. Their flights over the Atlantic to Casablanca, over the Mediterranean, and on to China were filled with experiences that make good reading. In China they transported troops and supplies for the Chinese Army.

The book is an excellent account of military air-transport work, particularly for boys and girls since it will increase their interest in the study of geography.

The How of the Helicopter, by Alfred H. Stevens, Jr.; Cornell Maritime Press, New York, 1946; 58 pages, $2.00.

Information about helicopters is collected in a book for boys and girls in their 'teens. The volume explains how helicopters were invented, how they operate, and how they are flown. Clarifying illustrations are included.

HISTORY

New York, an American City, 1783–1803, a Study of Urban Life. Sidney I. Pomerantz. New York, Columbia University Press, 1938. 531 pp., illus. $5.00. A detailed social history, including brief mention of ballooning activities.

MANAGEMENT

Job Evaluation. Forrest H. Johnson, W. Boise, W. Roberts, and Dudley Pratt. New York, John Wiley & Sons, Inc., 1946. 288 pp., diagrs. $3.75. Written to satisfy the need for a textbook explaining how a job evaluation program functions under actual operating conditions. Based in part on studies of aircraft and other companies.

MATERIALS—PLASTICS

Plastics Handbook for Product Engineers. John Sasso. New York, McGraw-Hill Book Co., Inc., 1946. 468 pp., illus., diagrs. $6.00. Practical and fundamental data on plastics and synthetic rubber for designers and engineers. The properties of all types of plastics; their selection for given applications; machining and finishing plastic parts; and design details such as tolerances, threads, and fastenings are discussed. Data are given about the causes and remedies of common faults in molded plastic parts. Synthetic rubbers are also covered from both the chemical and engineering standpoints.

Plastics, Scientific and Technological. H. Ronald Fleck. 2nd edition. London, The English Universities Press Ltd., 1946. 360 pp., diagrs., tables. 30*s*. New material has been added in this edition of a textbook first published in 1944. It is a concise work on the chemistry and technology of plastics with references to the literature, and useful name and subject indexes.

MATHEMATICS

Calculus. Frederic H. Miller. 2nd edition. New York, John Wiley & Sons, 1946. 416 pp. $3.50. Material added in this edition includes a discussion of graphical differentiation, a summary of the processes on integration, a theorem on moments of inertia, a discussion of approximate integration, and numerous illustrative examples. The emphasis is placed on fundamental material and complete and rigorous treatment. The author is a professor of mathematics at The Cooper Union School of Engineering.

Cours d'analyse Infinitesimale. (Course in Infinitesimal Analysis.) Ch.-J. de la Vallée. New York, Dover Publications, 1946. 2 Vols. 460, 524 pp. $7.50. First American edition in French of a work on advanced calculus and the principles of analysis which had its eighth revised edition in Belgium in 1938. It is intended to answer the needs of students of engineering, physics, chemistry, and mathematics.

Engineering Trigonometry. Edward M. J. Pease and George P. Wadsworth. Scranton, Pa., International Textbook Co., 1946. 479 pp., diagrs. $2.75. An introductory text that assumes no previous knowledge of the subject on the part of the student. Problems are separated into "Conventional Problems" and "Engineering Applications." An underlying purpose of the text is to bridge the gap between the study of mathematics and its application in engineering.

Higher Mathematics for Students of Chemistry and Physics. J. W. Mellor. New York, Dover Publications, 1946. 641 pp., diagrs. $4.50. A reprint edition of a standard British book, notable for the clarity of its text and illustrative examples.

Lectures on Differential Equations. Solomon Lefschetz. Princeton, Princeton University Press, 1946. 209 pp., diagrs. $3.00. Reproduced from typewritten copy. Recent lectures in which the author endeavored to provide background and preparation for further study and research. The first three chapters deal with more familiar questions. The final three chapters take up two-thirds of the book and cover asymptotic behavior and stability of the solutions near critical points following the method of Liapounoff; the Poincaré-Bendixson theory of planar characteristics in the large; and an analytic treatment of certain nonlinear differential equations of the second order.

Lectures on the Calculus of Variations. Gilbert A. Bliss. Chicago, University of Chicago Press, 1946. 296 pp. $5.00. The presentation of the ideas and principles underlying modern theories of the calculus of variations is made as simply and conclusively as possible in the first part, dealing with the calculus of variations in three-space, sufficient conditions for a minimum, fields and the Hamilton-Jacobi theory, problems in the plane and in higher spaces, problems in parametric form, and problems with variable end points. The problem of Bolza is taken up in the second part and a bibliography of this subject is appended. In another appendix theorems of the applications of the existence theorems for implicit functions and differential equations are recorded with simplified proofs. The author points out that there are few illustrative examples available which have been worked out in detail in the light of modern theory. He lists some in the text and gives sources for others.

Mathematical Aids for Engineers. Raymond W. Dull. New York, McGraw-Hill Book Co., Inc., 1946. 346 pp., diagrs. $4.50. Certain

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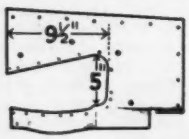

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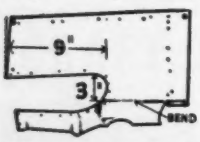

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fundamentals of the higher mathematics of engineering in a form suitable for reference or study. The author, who has also written *Mathematics for Engineers*, states that the purpose is to meet new developments of the past few years. Some of the subjects covered include uniform scales, organic growth, circles as tools, forces and couples, ray and string polygons, energy rotation, and images.

Mathematical Tables Project. Tables of Fractional Powers. New York, Columbia University Press, 1946. 486 pp. $7.50. Reproduced from typewritten copy. A compilation of tables of decimal and fractional powers, divided into two parts. The values in the first part are for fixed bases and variable exponents while those of the second part are for variable bases and frequently occurring exponents.

Trigonometry Refresher for Technical Men. A. Albert Klaf. New York, McGraw-Hill Book Co., 1946. 629 pp., diagrs. $5.00. The same question-and-answer method that was so effective in the author's *Calculus Refresher for Technical Men*, is used in this work. The answer to each question includes a fully worked out example, and each chapter ends with problems, of which the odd-numbered ones are answered separately.

MILITARY AVIATION

Incendiary Warfare. George J. B. Fisher. New York, McGraw-Hill Book Co., Inc., 1946 125 pp., diagrs. $3.00. Covers the nature and development of the incendiary bomb and projectile, the tactics of incendiary bombing, wartime fire, defense, preparedness against incendiary attack, and the evolution of incendiary warfare. This is an authoritative work presenting much technical material that has been under secrecy regulations until now.

Our Fighting Planes. Reed Kinert. New York, The Macmillan Co., 1946. 160 pp., illus. $3.75. Seventy-five excellent full-page illustrations, many in color, show U.S. military aircraft in action. Facing each plate is a page of comment and specifications.

Peace Through Air Power. New York, Air Power League, 1946. 32 pp., illus., diagrs. Theories for our defense in the immediate future, with diagrams and text dealing with such aspects of air power as personnel, training, bases, research, and unification of the armed forces.

MODELS

Gas Models and Engines. William Winter and Walter Schroder. New York, Thomas Y. Crowell, 1946. 183 pp., diagrs. $3.00. Gives complete instructions on the design, building, and flying of gas-propelled model airplanes, both control-line and free flight. Engines, airfoils, propellers, materials and technique of covering, and structural and aerodynamic design are treated in detail. The instructions on the handling and flying of models are clear and specific. Data on flying wings, flying boats and seaplanes, tailless airplanes, and biplanes are included.

PHOTOGRAMMETRY

Applied Photogrammetry. Ralph O. Anderson. 4th edition. Chattanooga, Tenn., 1946. 518 pp., illus., diagrs. Reproduced from typewritten copy. $6.00. The original work of this title is here combined with *Rigorous Analysis of the Scale-Point* and *Tilt of the Aerial Photograph by Graphical Representation*, which formerly were published separately. New material is added covering the precise formula for relief and tilt, the tilt displacement law, horizontal-line tilt determinations, locating the approximate swing line, and locating the approximate nadir point.

PHYSICS

Analytical Experimental Physics. Harvey Brace Lemon and Michael Ference, Jr. Revised edition. Chicago, University of Chicago Press, 1946. 588 pp., illus. $8.00. This excellent textbook was developed from experience in the teaching of physics at the University of Chicago. The

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Electron and Nuclear Counters; Theory and Use. Serge A. Korff. New York, D. Van Nostrand, Inc., 1946. 212 pp., diagrs. $3.00. Data regarding the discharge mechanism and the practical operation of various types of counters are summarized for use by graduate students, industrial laboratories, and research institutions.

PRODUCTION

Aircraft Layout and Detail Design. Newton H. Anderson. 2nd Edition. New York, McGraw-Hill Book Co., Inc., 1946. 437 pp., illus., diagrs. $4.50. New edition of a work prepared for students and for detailers in the engineering departments of aircraft plants. Information has been added covering the design of forgings, and of sand, permanent mold, and die castings, machine fittings, the principles of equilibrium, the mechanical properties of materials, and the plotting of bending moment and shear diagrams. Many new illustrations and problems have also been prepared.

A First Guide to Quality Control for Engineers. Gt. Brit., Ministry of Supply. London, His Majesty's Stationery Office, 1945. 46 pp., diagrs. 1*s*. A manual intended for practical use by engineers, using examples taken from actual engineering works.

Geometry of Engineering Drawing; Descriptive Geometry by the Direct Method. George J. Hood. 3rd edition. New York, McGraw-Hill Book Co., Inc., 1946. 362 pp., illus., diagrs. $2.75. A new edition of a work in which the techniques and principles of visualization of a three-dimensional object and of its flat projections and planes is explained. Rules are avoided. The diagrams are supplemented by photographs and problems are collected separately in 81 pages at the end of the volume. New material including a chapter on views and their relations, and a chapter on pictorial views, have been added to this edition. All the 900 problems are new. Applications to aircraft design are given and the work aims at being fully comprehensive.

High Vacuum Technique; Theory, Practice, Industrial Applications and Properties of Materials. J. Yarwood. 2nd edition, rev. New York, John Wiley & Sons, Inc., 1946. 127 pp., diagrs. $2.75. An American reprint of a British work with new sections dealing with the performances of vacuum pumps, the construction of vacuum systems, and extra methods of measuring low pressures, and pumping speed. Additions have been made to those parts of the text dealing with the oil-diffusion pump, gas-filled tubes, and the properties of materials. New diagrams and a 7-page bibliography are included.

Metco Metallizing Handbook. 4th Edition New York, Metallizing Engineering Co., Inc., 1946. 85 pp., illus., diagrs. Reproduced from typewritten copy. $2.00. Covers surface preparation, spraying technique, corrosion-resistant coating, finishing of sprayed metals, and metallizing wires.

Statistical Quality Control. Eugene L. Grant. New York, McGraw-Hill Book Co., Inc., 1946. 563 pp., illus. $5.00. A working manual intended to supply practical working rules. The book was developed from courses given at Stanford University and embodies the author's conviction that all manufacturing businesses may make some effective use of the techniques described. Among the practical examples given illustrating basic principles are many from the aviation industry.

X-Rays in Practice. Wayne T. Sproull. New York, McGraw-Hill Book Co., Inc., 1946. 615 pp., illus. $6.00. A text with questions and problems, covering generation, absorption, scattering and diffraction of X-rays; measurement and recording of X-rays; equipment, industrial radiography, medical applications, crystallography, fluoroscopy, automatic inspection, microradiography, and other applications.

REFERENCE BOOKS

A.S.M.E. Mechanical Catalog and Directory, 1947. New York, American Society of Mechanical Engineers, 1946. 792 pp., illus. The thirty-sixth annual issue.

Aviation Industry Red Book. 3rd annual ed. New York, The Haire Publishing Co., 1946. 160 pp. $2.00. A classified directory of manufacturers and products.

Bibliography on Combustion, 1927—Jan. 1, 1945. Compiled by Jack Lotsof. Buffalo, Curtiss-Wright Corp., Research Laboratory, Library, March 21, 1945. 34 pp. Reproduced from typewritten copy. About 375 references, including items pertaining to combustion in the gas turbine and on the combustion of materials that could logically serve as fuels for engines or turbines.

British Interplanetary Society. Annual Report and List of Members. London, 1946. 16 pp. Members' addresses are included and the list is corrected to September 30.

Dictionary of Technical Terms. Frederic S. Crispin. 7th edition., rev. Milwaukee, Bruce Publishing Co., 1946. 427 pp., illus., diagrs. $2.75. Entries are in the form of short definitions. It is stated that this edition includes many new words resulting from wartime technological developments.

Marine Catalog and Buyers' Directory, 1946–1947. New York, Simmons-Boardman Pub. Corp., 1946. 682 pp., illus. The fourth annual issue.

Modern Plastics Encyclopedia, 1946; Plastics Catalog Charts. New York, Industrial Magazine Service, Inc., 1946. $3.75. Ten folded wall charts on plastics identification, properties, classification, formulas, manufacturing flow charts, solvents, adhesives, and plastics used in liquid coating, to accompany the *Modern Plastics Encyclopedia*.

S.A.E. Handbook, 1946. New York, Society of Automotive Engineers, Inc., 1946. 842 pp., illus., diagrs. $5.00. Latest edition containing lists of aeronautical current standards and recommended practices and the texts of codes and forms of the S.A.E. in effect at the time of publication.

Who's Who, 1946. New York, The Macmillan Co., 1946. 3,050 pp. $18. The ninety-eighth year of issue of the British standard biographical annual.

RESEARCH

Industrial Research and Development in the United Kingdom. Sir H. Frank Heath and A. L. Hetherington. London, Faber and Faber, Ltd., 1946. 375 pp., illus. 25*s*. This is a comprehensive survey of the position of industrial research and development in the United Kingdom up to the end of 1944. The chief manufacturing industries and utilities, government and private research activities, and general factors such as patents, education, standardization, and industrial design are included.

STRESS ANALYSIS AND STRUCTURES

Advanced Mechanics of Materials. Glenn Murphy. New York, McGraw-Hill Book Co., Inc., 1946. 307 pp., illus., diagrs. $4.00. A book designed for an advanced undergraduate or graduate course. Many problems of a wide range of difficulty are given with each chapter. The topics covered include the relationships among stresses and strains at a point, theories of failure, axial loading, stress concentrations, thick-walled cylinders, torsion of noncircular members, unsymmetric bending, curved beams, shear center, stresses near concentrated loads, and buckling of panels, sheets and thin-walled members. Emphasis is placed upon the three fundamental tools of stress analysis—statics, geometry, and the properties of the material.

TELEVISION

Report of the Television Advisory Committee, 1943. London, His Majesty's Stationery Office, 1945. 25 pp. 6*d*. Findings regarding prewar and postwar service, research and development, and guidance to manufacturers.

WORLD WAR II

Builders for Battle; How the Pacific Naval Air Bases Were Constructed. David O. Woodbury. Introduction by Vice Adm. B. Moreell. New York, E. P. Dutton and Co., Inc., 1946. 415 pp., illus. $7.50. This is a lively account of the tremendous job of constructing naval air bases in the Pacific up to the time the Seabees took over. It is an amazing record of achievement in a short time. The book is well illustrated by Lili Rothi and Louis H. Ruyl.

Fighter Pilot. Levitt Clinton Beck, Jr. California, Wetzel Publishing Co., 1946. 199 pp., illus. $2.50. Lieutenant Beck, a P-47 pilot, was 24 years old when he died at Buchenwald, November 29, 1944. This autobiography was written in 18 days while he was in hiding in Paris, and the manuscript reached his parents through the French Underground.

One Damned Island After Another. Clive Howard and Joe Whittley. Chapel Hill, University of North Carolina Press, 1946. 403 pp., plates. $3.50. The combat history of the Seventh Air Force from Pearl Harbor to the end of the war against Japan. Told in smooth narrative style.

Pathfinders. William Anderson. London, Jarrolds Pub., Ltd., 1946. 112 pp., illus. 16*s*. The author's experiences as a master bomber with the Pathfinder Force of the R.A.F. His job was to drop flares and later colored target indicators for following bombers. He was also navigator of the Lancaster "Aries" which flew over the North Pole on a training flight in 1945.

70,000 to 1; The Story of Lieutenant Gordon Manuel. Quentin Reynolds. New York, Random House, 1946. 217 pp. $2.50. Story of a flier cast ashore on a Pacific island teeming with enemy troops.

Uncommon Valor; Marine Divisions in Action. George McMillan. Washington, Infantry Journal Press, 1946. 256 pp., maps. $3.00. The 1st to 6th Marine divisions' actions in the Pacific described by the correspondents who accompanied the six units.

Batailles dans le Ciel (Battles in the Sky), by Marcel Migeo; Editions Colbert, Paris, France, 1942; 236 pages, 28 frs.

The early struggle made by the French Air Force against the enemy, beginning in the fall of 1939, is narrated. The purpose is to provide a clear and sympathetic understanding of the lives, operational activities, and emotions of those fliers. The book is divided into three parts, the first of which deals with a pilot of World War I who flies again in the second conflict. His observations, his experiences with the younger aviators, and their reactions toward each other, form the basis of the recital.

The second part relates the story of the "War with Paper," the operational experiences of a squadron that dropped propaganda leaflets. Personalities and personal exploits are emphasized, and a detailed account is given of the inferior equipment with which the airmen were forced to work.

The last part is written in journal form, telling the story of the 12th Squadron, stationed in the south of France. A firsthand account of the lives and operational duties of the men can be found in the pages of this diary.

These Nickel alloy steels, used in NAvion components listed below, may offer advantages to you.

ENGINE PARTS—A six-cylinder, air-cooled Continental engine powers the NAvion plane manufactured by North American Aviation, Inc. Adhering to standard practice in aircraft engine design, heat-treated Nickel alloy steels are used for the more highly stressed working parts . . . to assure maximum flying safety and long, trouble-free operation.

EXHAUST STACK—Type 347 stainless chromium-Nickel steels stabilized with columbium are used to combat both corrosion and high temperature effects.

CANOPY TRACK AND ADJUSTABLE SEAT TRACK—To resist atmospheric corrosion and insure smooth-sliding operation, these tracks are made of Type 302 (18-8) chromium-Nickel stainless steel.

FIREWALL—For maximum protection to pilot and passengers, the firewall between engine and fuselage is made of Type 302 (18-8) corrosion resistant stainless steel.

LANDING GEAR—Here, three basic reasons led North American to specify "8630" Nickel Chromium-molybdenum steel tubing—uniform strength, toughness after suitable heat treating, and ready fabrication by welding.

For safety and dependability, use Nickel alloy steels.

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Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of alloys containing Nickel. This information and data are yours for the asking. Write for "List A" of available publications.

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Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aerodynamicists, Flight Test Engineers, Mechanical Engineers, Electronics Engineers, Physicist Mathematician, Administrative Engineer—Competent to assume additional responsibility in an expanding engineering organization as staff and project engineers on new, diversified, challenging work in the development of complex aviation devices. Only those applicants possessing initiative and ability to think analytically are desired. Plant is located approximately 200 miles west of New York City. Wages paid are equal to, or above, locality average. For further details write to: Personnel Manager, Link Aviation Devices, Inc., Binghamton, N.Y.

Structural Designers—Experienced in sheet-metal aircraft structures for new helicopter design. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Layout Draftsmen—Five or more years' experience on aircraft layout and design. Rotary wing preferred. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Aerodynamicist and Vibration Specialist—Experienced in rotary wing field. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Translators—Part-time, N.Y. residents, to abstract and translate foreign language articles on aviation. Must be thoroughly familiar with aviation terms of at least one language. Submit language experience, background, etc., to Accurate Translation Service, 711 Woodward Building, Washington 5, D.C.

Assistant Designer—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must be capable of taking full responsibility for undercarriage design projects, and should have had some experience in design of hydraulic pumps, systems, and electro-hydraulic units. Knowledge of stress analysis and familiarity with both British and American engineering practices also desirable. This is a permanent position with good prospects. Starting salary $275 to $300 per month, depending on qualifications. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Senior Draftsman—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must have minimum of 3 years' experience in the more mechanical side of aircraft design work and, preferably, 1 year's design experience on undercarriage and hydraulics, variable-pitch propellers, fuel systems, or other similar accessories. Should be capable of detailing any undercarriage or hydraulic layout and of carrying out elementary stress analysis. Familiarity with both British and American engineering practices also desirable. This is a permanent position with attractive prospects. Starting salary proportional to qualifications offered. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Assistant or Associate Professor—To teach courses in aerodynamics and wind-tunnel and airplane design. Must have graduate work in aerodynamics. Prefer man with teaching and practical experience. Salary and position will depend upon qualifications. Applicants should submit detailed record of education and experience. Address reply to Aeronautical Engineering Department, University of Kansas, Lawrence, Kan.

Aerodynamicists and Aeronautical Engineers—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new designs of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply please give brief summary of personal qualifications, education and experience. Address: Director, David Taylor Model Basin, Washington 7, D.C.

Layout Draftsmen—College graduates preferred, with aeronautical or mechanical engineering degrees. Must have 3 to 5 years' experience in aircraft industry as layout draftsmen working on structures, stress analysis, and design. Plant located just outside Washington, D.C. Address inquiries to Engineering and Research Corporation, Riverdale, Md.

Engineers and Physicists—The Cleveland Laboratory of the National Advisory Committee for Aeronautics has openings for engineers and physicists to work in fundamental research applicable to aircraft propulsive systems. Research is in progress on engine performance, fuels, thermodynamics, compressors, turbines, and materials. Applications of the principles of fluid mechanics are being investigated in the speed ranges covered by subsonic, transonic, and supersonic flow rates. There are openings for professional men ranging from a starting rate of $2,644.80 per annum for men just out of college to $8,179.50 per annum for men with qualifying experience in their respective fields. Apply to National Advisory Committee for Aeronautics, Cleveland Airport, Cleveland, Ohio; Attention, Mr. John D. Tousignant.

Chief Aerodynamicist—Services of highly qualified aerodynamicist required to act as Chief Aerodynamicist. Applicants must be graduate engineers from recognized universities. Experience on personal aircraft desirable. Applicants should write, giving complete details of education, experience, and salary expected, as well as availability, to Fleet Manufacturing and Aircraft Limited, Fort Erie, Ontario, Canada.

Assistant or Associate Professor—An assistant or associate research professor with strong theoretical background wanted to engage in research in the field of stability and missiles. Advanced degrees preferred. Salary commensurate with training and experience. Apply by letter giving details of educational background, experience, salary expected, availability, and personal history, to D. W. Dutton, Director, Daniel Guggenheim School of Aeronautics, Georgia School of Technology, Atlanta, Ga.

Professor of Aeronautical Engineering—To teach advanced courses in aircraft design, materials and processes, and structures. Opportunity for research work in newly organized Navy Ordnance program provides for full year-round employment. Rank and salary dependent on educational background and experience. Considerable experience in aircraft industry and a permanent interest in teaching are desirable. Address: Dr. M. J. Thompson, Chairman, Department of Aeronautical Engineering, The University of Texas, Austin 12, Tex.

Aerodynamicists—One or two positions open for experimental and theoretical research in supersonic aerodynamics in Navy Ordnance development program. Preference given to applicants with experience in supersonic field but will consider those with good background of fundamentals and subsonic work who wish to acquire experience in supersonics. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12, Tex.

Physicist or Research Engineer—To do basic research and development work in applied optics related to supersonic airflow visualization. Work includes application of spark and schlieren photography and interferometry to supersonic wind tunnel test program. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12, Tex.

Electronics Engineers, Project Engineer—The U.S. Naval Air Station, Quonset Point, R.I., has vacancies for highly qualified and experienced electronics engineers P-5, at $5,905.20 per annum; P-6, at $7,102.20 per annum; and a project engineer, P-3, at $4,149.60 per annum. Applications (Civil Service Form 57) are desired from persons who feel that they are capable of performing at the above-mentioned professional level, and should be mailed to the Recorder, Board of U.S. Civil Service Examiners, U.S. Naval Air Station, Quonset Point, R.I.

Chief Engineer—Experienced engineer needed to assume responsibility for stress analysis and C.A.A. approval of new personal airplane. Initial position would be as Chief of Structures, with opportunity to assume Chief Engineer's position if experience and other qualifications are satisfactory. Opportunity for investment in the company if desired. Address replies to The Dansaire Corporation, Dansville, N.Y.

Mechanical Engineers, Designers and Layout Draftsmen—Having a minimum of 3 years' industrial experience on small electromechanical devices. Positions are in the Engineering Division of the makers of the Link Trainer. Engineering degrees or equivalent are required for engineering and designing positions. Forty-hour week allows leisure to enjoy area's many outdoor activities. Wages paid are equal to, or above, locality average. Send all particulars to Personnel Manager, Link Aviation Devices, Binghamton, N.Y.

Aeronautical Engineers—The Board of U.S. Civil Service Examiners, U.S. Naval Air Station, Quonset Point, R.I., announces that a limited number of applications are now being accepted for the position of Aeronautical Engineer (Power Plants), P-3, $4,149.60 per year. Applicants must show that they have successfully completed a full 4-year course leading to a Bachelors' Degree in Aeronautical Engineering in a college or university of recognized standing; or 4 years of successful progressive aeronautical engineering experience. In addition, applicants must show 3 years of progressive professional aeronautical en-

gineering experience involving aircraft power plants. Graduate study in aeronautical engineering involving aircraft power plants successfully completed in a college or university of recognized standing may be substituted for experience year for year, up to a maximum of 3 years. Applicants applying for this position should mail Standard Civil Service Form 57 to: Recorder, Board of U.S. Civil Service Examiners, U.S. Naval Air Station, Quonset Point, R.I.

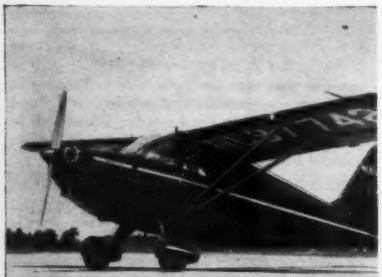
Research Engineer—Responsible position open with small corporation engaged in development engineering on aircraft instrumentation and control systems. Background of mechanical engineering or applied physics required. Address inquiries to Box 388, Richmond, Va.

Thermodynamicist—With strong theoretical background to engage in research work in the field of jet propulsion. Advanced degrees preferred. Replies will be held in strict confidence. Write Cornell Aeronautical Laboratory, Employment Office, Buffalo 5, N.Y.

651. **Aeronautical Administrative Engineer**—Experienced in handling Navy Contract procedures and in designing for production. All replies will be held confidential. East Coast company.

643. **Professor of Aeronautical Engineering**—To take charge of this work in a well-established department where specialization is largely in aircraft propulsion and aerodynamics. Large graduate enrollment, good industrial contacts, and opportunities for consulting and research work. Salary attractive.

640. **Stress Engineer**—Highly qualified engineer, up-to-date on commonly used stressed-skin methods, wanted for a Swedish aircraft company for a period of 1 to 2 years. Good salary and traveling expenses paid. In applying please give brief sketch of personal qualifications, education, and experience.



Right on the nose of the Stinson Voyager 150

READY to wing into the blue is Stinson's new sleek Voyager 150. Every inch of her is soundly engineered. And she's out in front with a prop that's renowned for outstanding performance—a Sensenich. For nearly a quarter of a century Sensenich has been building quality propellers. That is why most personal plane manufacturers specify Sensenich.

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LANCASTER, PA. GLENDALE, CALIF.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

634. **Chief Engineer**—Leading aircraft accessory firm making mechanical devices for aircraft. Located in a desirable Midwest city. Excellent opportunity for the proper man. Should be experienced in machine design, electrical design, small mechanisms, and possibly small rotating machinery. Must be experienced in handling people, supervising design, making engineering decisions for production, and supervising large number of projects. Please send complete information in first letter on entire background, including salary requirements and recent salaries. Our employees know of this opening and therefore applicants will not be embarrassed by writing to their own employer.

629. **Assistant Professor**—To conduct classes in airplane detail design and stress analysis in large engineering college. Must have aeronautical engineering degree and industrial experience. Advanced degree preferred but not essential. Immediate appointment. In replying, please submit brief record of education and experience.

627. **Aeronautical Engineer**—Civil Service position open immediately in Washington, D.C., for aircraft engineer with several years of progressive experience in structural design. Good opportunity for permanent appointment for engineer having proper qualifications. Duties involve responsibility for accurate investigations of special design problems and authoritative review and evaluation of major structural design features of new military aircraft to ensure compliance with Navy requirements and good engineering practice. Salary $5,905 per year. In applying give brief sketch of personal qualifications, education, and experience.

626. **Propeller Project Engineer**—Immediate permanent opening for project engineer with design experience in controllable-pitch propellers from 65 to 200 hp. Good testing facilities available and excellent opportunity for advancement with established Mid-West manufacturer. Reply stating full particulars of past experience, salary required, and other useful information.

616. **Associate or Full Professor**—A leading Midwestern university which is developing an extensive graduate instruction and research program in the fields of high velocity aerodynamics and jet propulsion needs an additional permanent staff member. Teaching will consist of one-third to one-half of load, balance on research. Rank will be Associate or Full Professor. Salary attractive; advanced degree required plus practical experience.

608. **Patent Engineer or Attorney**—Position requires at least 5 years' industrial experience in the preparation of patent applications covering electromechanical and electronic mechanisms such as control systems, servomechanisms, industrial instruments, automatic pilots for aircraft or gyro instruments. Electrical Engineering or Physics degree combined with degree in Patent Law preferred but not mandatory. Position requires ability to assume full charge of a small Patent Department, persistent follow-up of engineers to obtain patentable ideas.

607. **Design Engineer**—Position requires at least 5 years' industrial experience in the layout and design of electromechanical mechanisms such as controls, industrial instruments, aircraft instruments, automatic pilots, or gyro instruments. Engineering degree preferred but not mandatory. Position requires ability to assume responsibility for the mechanical design in connection with one or more projects and close cooperation with the Project Engineer.

606. **Senior Project Engineer**—Position requires at least 5 years' industrial experience in the basic development and design of electromechanical and electronic mechanisms such as control system, servomechanisms, industrial instruments, automatic pilots for aircraft, or gyro instruments. Electrical Engineering or Physics degree preferred but not mandatory. Position requires ability to direct several assistants in the handling of one or more major projects.

605. **Senior Designers**—Wanted by aircraft-engine manufacturer. Will make major design layouts of engine and component parts. Must be able to make all necessary design computations. Should have several years' experience with internal combustion engines. Location Midwest.

604. **Senior Layout Men**—Wanted by aircraft-engine manufacturer. Must have extensive experience with internal-combustion engines. To make complicated layouts from specifications, drawings, sketches, or notes furnished by engineers or designers. Should have considerable knowledge of manufacturing processes. Location Midwest.

598. **Aeronautical Engineers**—Immediate positions open in Washington, D.C., for aircraft engineers with practical experience in preliminary investigations of new aircraft designs and airplane performance. Salary between $4,149 and $4,902 per year. In applying please give brief sketch of personal qualifications, education, and experience.

597. **Aeronautical Engineers**—Immediate positions open in Washington, D.C., for aircraft engineers with practical experience in structural design and research. Salary between $3,397 and $5,905 per year. In applying please give brief sketch of personal qualifications, education, and experience.

595. **Modelmakers**—Craftsmen skilled in the use of hand and power tools to close tolerances wanted for model work by growing industry in the West. Experience in making wind-tunnel, free flight, and tow basin models for Army, Navy, N.A.C.A., or industry desirable. Position permanent. Please state full particulars in first letter, including age, experience, references, and salary desired.

593. **Resident Sales Engineers**—Near New York, Boston, Bangor, Albany, Scranton, Philadelphia, Richmond, Roanoke, Columbia, Jacksonville, Birmingham, Nashville, Cincinnati, Pittsburgh, Buffalo, Detroit, Chicago, St. Louis, Little Rock, New Orleans, San Antonio, Dallas, Oklahoma City, Kansas City, Omaha, Minneapolis, Helena, Casper, Denver, Albuquerque, Phoenix, Salt Lake City, Carson City, Boise, Seattle, Portland, San Francisco and San Diego. If you live within a reasonable distance from these cities and are willing to represent a new young firm of consultants in them and surrounding communities on a straight commission basis, kindly submit your complete background and present status.

586. **Project Engineer**—To handle a complete helicopter development program. Should have not less than a Bachelor's degree in engineering and at least 5 years of rotary wing experience. In replying, applicants should submit complete background information and a recent photograph.

584. **Chief Project Engineer and Several Project Engineers**—For design and development work in various forms of jet propulsion. Prefer men having some experience with rockets, ramjets, pulse-jets or turbojets. Experience in performance analysis desirable. Eastern location. Reply by letter stating details of education, experience, personal data, and salary desired.

583. **Aerodynamicist**—For design and development of diffusers, nozzles, compressors, etc., in connection with jet propulsion development program. Prefer man familiar with transonic and supersonic airflow. Eastern location. Reply by letter stating details of education, experience, personal data, and salary desired.

582. **Thermodynamicist**—Preferably with internal combustion experience for development work in connection with various forms of jet propulsion systems, including cycle analysis, com-

bustion chamber design, etc. Familiarity with rocket and jet fuels desirable. Eastern location. Reply by letter stating details of education, experience, personal data, and salary desired.

581. **Aeronautical Engineer**—With airplane stability and control experience wanted by electronics company engaged in guided-missiles development. Location in vicinity of Boston. Good opportunity for right man.

568. **Personnel**—An expanding southern New England helicopter company has positions available in several fields for personnel interested in rotary wing aircraft. Experience in helicopters is desired but not necessary. Give full education and experience.

567. **Engineers**—One of the largest engine companies located in Midwest engaged in extensive and continuing development program on nonrotating aircraft propulsion engines has openings for the following personnel:

Development Engineer—An idea man with good theoretical and practical background to direct activities of engineering group devoted to preliminary design and analysis.

Thermodynamicist — Research - minded with good theoretical background, advanced degrees preferred.

Vibrations and Structures Engineer—A man with aircraft and aircraft engine design experience, with an interest in analytical vibration problems.

Instrumentation Engineer—A man with a good understanding of wind-tunnel instrumentation, familiar with electronic, optical, and other instrumentation means suitable for use in studying aerodynamic and thermodynamic problems.

Mechanical or Aeronautical Engineers—Up to 5 years' experience, interested in research and development activity in a rapidly expanding program.

Aerodynamicist.

Physicist.

490. **Assistant or Associate Professor**—Sought by Aeronautics Department of Engineering College to teach undergraduate and graduate courses in aerodynamics, aircraft structures, or aircraft propulsion. Must have good academic training and teaching experience; constructive interest in aeronautical research and development, preferably industrial or laboratory experience in this field. Starting salary range: $4,000 to $6,000 depending upon qualifications.

AVAILABLE

653. **Aeronautical Engineer**—Age 25, married. B.S. in Ae.E.; 2 years' experience as stress analyst in large aircraft plant. At present, graduate student at M.I.T. completing studies toward S.M. in Ae.E. in June. Desires work about July 1 in flutter or high-speed aerodynamics.

652. **Aeronautical Engineer and Aircraft Maintenance Engineer**—B.S. in Ae.E. Age 28, married. Five years' experience with A.A.F. as Aircraft Maintenance Officer with rank of Major. Maintenance experience on single-engined, twin-engined, and four-engined aircraft. Diversified experience in personnel management. Desires supervisory position wherein a high degree of responsibility must be held. Now holding responsible engineering position with leading air line.

650. **Physicist**—Age 34, B.S. and M.S. degrees in Mathematics and Physics. Thesis published in *Journal of Applied Physics*. Worked as engineer and developed patentable ordnance device for Navy. Two years as technical supervisor and writer for A.A.F. Technical Schools. Pilot. Four years as college instructor in mathematics and physics. Former officer in charge of Naval activity of up to 100 men. Desires position in either research or manufacturing.

649. **Aeronautical Management or Administration**—28 years old, married. B.S. in Mechanical Engineering from Purdue in 1940, with major in industrial engineering and aeronautical engineering courses. Four years' experience with large aircraft-engine manufacturer as an engineering trainee and as a field service representative and 2 years as a power-plant engineer for a transcontinental air line. Desires permanent position in management or administration of an aeronautical concern with an opportunity for advancement.

648. **Field or Sales Engineer**—Five years' experience in foreign and domestic field in installation and sales engineering for major aircraft instrument company. Experience includes work with latest-type gyros and automatic flight control and automatic approach control equipment Three years' contact with aircraft concerns in Southern California. Desires position on West Coast.

647. **Design Engineer**—Degree of B.S. in Ae.E., with 2 years' experience in aerodynamics and detail design relating to advanced aircraft with a large West Coast company. Desires position with a future involving research and design. Also possesses ability in design illustration. Any location considered.

646. **Administrative**—Desires responsible administrative connection, and will consider investment, in new or expanding aviation enterprise. Has extensive knowledge and resourcefulness resulting from training in aviation specialties, business administration, and manufacturing, plus active association with aviation during past 10 years and prior experience in business organization, office management, accounting, manufacturing, and sales. Capable of handling personnel and developing a well-rounded organization.

645. **Associate Professor of Aeronautical Engineering**—Doctor of Aeronautical Engineering in a large Mid-Western university would like to change his position for a similar one. At the present time gives structural courses. Possesses experience in wind-tunnel operation and a thorough knowledge of aerodynamics.

644. **Foreign Sales Engineer**—Internationally known aeronautical engineer and editor, 10 years of foreign experience, linguist, desires position as foreign sales manager, sales engineer, or European contact man for American aircraft or aircraft equipment manufacturer. Willing to locate in Europe. Has influential Governmental, commercial, and private contacts in various countries. Top references available. Age 40, personable, executive type.

641. **Aeronautical Engineer**—B.Ae.E., Rensselaer Polytechnic Institute, 1939. Age 31, married. Private pilot. Eight years' design and field engineering work including administrative and supervisory experience for major aircraft accessory manufacturer. Ground and flight test experience, both Army and postwar commercial planes. One year project engineer and market analyst for development of light-plane products. Well-established West and East Coast aircraft contacts. Desires administrative or sales engineering position in aircraft or allied industry. Prefers East or West Coast. No objection to traveling. Available immediately.

639. **Stress Analyst**—Ten years' varied experience as stress analyst. In charge of complete stress and static test data for several small companies. Chief of Structures for a well-known personal plane manufacturer. Experienced in all-wood, steel tubular, and all-metal aircraft. Desires position relating to structures and utilizing the maximum of experience. Midwest or Eastern location preferred.

638. **Aeronautical Engineer**—B.S. in M.E., 1934, New York University (Guggenheim School of Aeronautics). Eight years' general aircraft engineering experience, including positions as Project Engineer, Chief Aerodynamicist, and Acting Chief Engineer on Naval aircraft, helicopters, and amphibians. Available for responsible position immediately.

637. **Mechanical and Aeronautical Engineer**—B.S. in M.E., Aeronautical Engineering option, 1936. Will receive M.S. degree in M.E. during present school year. Two years' experience machine tool design. Three and one-half years' experience in aircraft propeller design and vibration research. Almost 1 year's experience in aircraft automatic landing electronic equipment research. Thirty-nine months' service in Army Air Forces Air Matériel Command's Engineering Division Laboratories as Project Officer with considerable supervisory responsibilities. Highest references. Desires position in engineering liaison, sales, or development in aircraft or mechanical equipment manufacturing.

636. **Mechanical Engineer**—Age 28. Interested in engineering sales. Three years' experience in steel industry as specification writer, field engineer, and maintenance foreman. Three years' experience in the aircraft industry as design layout draftsman and flight-test engineer. Employed at present by research and development engineering concern working on aircraft gas turbines.

635. **Sales Engineer**—Graduate aeronautical engineer with 4 years' experience in design of aircraft and hydraulic equipment; holder of private pilot certificate. Desires position as a Sales Engineer (not necessarily in aircraft). Single. Free to travel. Location open.

633. **Executive Assistant and Industrial Engineer**—Age 38, single; 13 years' engineering experience including cost analysis, planning and scheduling production, sales forecasting, budgetary control, etc., as well as airport management. Can assist on product development and production of plastic structures and/or prefabricated houses. Also qualified to handle business relations with Government agencies. Separating from A.A.F. after 2 years overseas and 3 years' procurement and development engineering.

632. **Aeronautical Engineer-Export**—B.Ae.E., Rensselaer Polytechnic Institute. Ex-Naval Officer with 1 year's liaison engineering experience on high-speed research; 1 year's electronics training in the Navy; 1 year's practical work in aircraft production; 3 months' experience as buyer for export, plus publicity work. Graduate of European high school; has done atomic physics graduate work. Desires participation in export or establishment in an engineering product manufacturing company or airways in Southern Europe, South America, New York, or Los Angeles area.

631. **Test Pilot**—Graduate aeronautical engineer. Over 4,000 hours' single- and multiengined ratings. Instrument and instructor ratings. Radio license. Three years' test pilot for Navy. Experienced in making engineering reports. Prefers test flying work with engineering work anywhere in the United States.

630. **Aeronautical Engineer**—Graduate. Seventeen years' well-rounded experience with several leading aircraft manufacturers and U.S. Navy. Jet-propelled and supersonic pilotless aircraft. Design supervisory, organizational, and executive background, all phases. Previous salary in $9,000 range.

628. **Professor of Aeronautical Engineering**—Bachelor's Degree in Physics; graduate work in mathematics. Author of engineering textbook in aerodynamics. Four years' teaching experience in aeronautical engineering department at Southern engineering school. Experience in teaching senior work in aerodynamics, airplane layout and design, and aerodynamic laboratory with instructional wind-tunnel work. At present in charge of all aeronautical courses and development of aeronautical laboratory in leading engineering university. Desires permanent professorship in aeronautical engineering department where aeronautical graduate work is available.

625. **Industrial and Aeronautical Engineer**—B.S. in Mechanical and Electrical Engineering; 2 years' postgraduate Aeronautical Engineering. Twenty-one years' naval aviator; wide ex-

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"Standards" for the innumerable parts that make up a complete machine tool must be just as rigid as those used in plane manufacture.

"Standards" of toughness, wearing qualities and precision in machine tools are a "MUST" if they are to turn out parts for planes, radar, other machine tools, etc., where accuracy and close tolerances are a vital factor.

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Active aid given in finding suitable housing. Apply by letter or in person to — Engineering Manager.

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BOX 642

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Layout Engineers and Stress Analysts urgently needed to continue expanding design program. Unlimited opportunities for men who meet our requirements. State age, education and experience.

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perience operating, maintenance and overhaul various types aircraft and engines. Retired as a Commander, U. S. Navy. Four years' shop superintendent in factory manufacturing aircraft and aircraft engines. Five years' quality manager for one of the largest aircraft manufacturers. Desires position as quality manager or manufacturing executive.

623. **Manufacturers' Technical Sales Representative**—Aeronautical design engineer experienced in technical sales representation desires connection with manufacturer or distributor of aviation products in selling to East Coast aircraft manufacturers. Ten years' experience in the aircraft industry includes positions as technical sales representative, design engineer, and project engineer. Salary or commissions. Holds pilot certificate and will travel in company owned or privately owned aircraft.

621. **Aeronautical Engineer**—B. of Ae.E., New York University. Three years' experience in aircraft stress analysis, including aerodynamic loading, salvage, and design. Some light-plane flying experience. Holds Marine Engineer's license obtained in service. Desires responsible position doing aeronautical or mechanical engineering work. New York City or adjacent area preferred. Available immediately.

620. **Executive**—French resident in U.S.A. since 1940. Varied experience in aeronautical, automotive, and mechanical engineering. Research minded, many ideas for future development. Has occupied high responsible administrative official positions. Recently, Consulting Engineer in charge of a complete helicopter project covered by his own patents. Desires position in which engineering background, administrative training, and knowledge of French and European countries would be of value.

619. **Public Relations Specialist**—B.S. in Commercial Aviation; Journalism minor. Ten years' experience aviation publicity and editorial work. Aggressive and tenacious with influential world contacts. Pilot, radio operator, and mechanic with working knowledge of engineering, manufacturing, distribution, and transport. Desires career position with aviation firm or agency aviation account. Location immaterial. Résumé on request.

618. **Meteorologist-Engineer**—Graduate meteorologist and engineer; B.S. Meteorology, New York University; B.S.M.E., Case School of Applied Science. Age 28. Served as commissioned meteorologist with A.A.F. in U.S. Served as operations and dispatch officer with A.T.C. overseas for 14 months. Three and one-half years in service. Position wanted with air line or other concern interested in air transportation. Interested primarily in flight operations or traffic promotion work. Holder F.C.C. radio permit and C.A.A. Tower Controller's Certificate. Will consider work in domestic or foreign fields.

615. **Aeronautical Engineer**—Age 27, B.A., Columbia University, 1939; B.S. in Aeronautical Engineering from M.I.T. in 1942; M.S. from M.I.T. in 1945 as result of course in servomechanisms and instrumentation sponsored by Army Air Forces. Associated for 4½ years with Army Air Forces Air Matériel Command, Engineering Division, as aerodynamicist concerned with aircraft stability and control problems, including direction of flight tests, instrumentation, analysis of wind-tunnel and flight-test data, and design evaluation. Desires position as aerodynamicist concerned with aircraft stability and automatic guidance problems.

614. **Experimental Test Pilot**—Available immediately for any research problem or experimental project in helicopter or conventional types of aircraft from small personal craft to four-engined or pursuit, land or sea. One thousand hours' experimental time in helicopters and military types of pursuit and multiengined. Six thousand hours' pilot time with 4,500 hours certified. Pilot since 1921, licensed since 1928. Formerly, Chief Test Pilot and Assistant Chief Experimental Test Pilot for prominent companies. Excellent experimental training in all phases of such operations, with high percentage of data obtained satisfactory to engineering. Checked out at Mayo Clinic altitude chamber and centrifuge with above average record. Commercial, single, and multiengined land, single-engined sea, and flight instructor ratings. Detailed résumé on request.

613. **Administrative or Executive Engineer**—Registered Professional Aeronautical Engineer, with over 8 years of broad administrative, supervisory, and some design experience, desires executive or administrative position in either prime or assisting capacity. Will definitely consider position in other than aircraft or allied industry, or any position requiring initiative, responsibility, and a combination of business and engineering experience and training. No objection to traveling. Geographical location unimportant.

612. **Airline Engineer**—Age 35, A & E licenses, Aeronautical degree; approximately 10 years' experience in maintenance and maintenance engineering with a major air line and recent experience as Assistant Chief Engineer for company manufacturing aircraft testing equipment. Seeks position with an air-transport company or manufacturer of aircraft equipment where intimate knowledge of air-transport maintenance problems and procedures will be of value.

611. **Manufacturing Executive**—M.E.; 26 years' experience in production management. Thoroughly familiar with all phases of modern methods and precision machinery, tooling, production control, procurement, and plant organization. Automotive and aircraft manufacturing background. Experience covers both aluminum and molded plywood construction.

610. **Aeronautical Engineer**—B.Ae.E., Rensselaer Polytechnic Institute. Age 22, single. Since July, 1945, connected with prominent East Coast light-plane producer as engineer. Experienced in structural design, aerodynamics, stress analysis, static testing, writing of reports for C.A.A. approval. Desires work associated with design and development of light planes. Associate member Sigma Xi, flying experience.

609. **Executive and Aeronautical Engineer**—Successful experience as Chief Engineer and in other responsible positions with major personal aircraft manufacturer. Well known by top industry and C.A.A. personnel; fully acquainted with C.A.A. procedure and operations and with industry methods and organization. Has also had successful management experience, and background of experience as ground instructor, pilot, A & E mechanic, navigator, radio operator, etc.; has thorough understanding of aviation from operator and private owner standpoint; and has acquired a sound working knowledge of factors affecting sales and advertising, purchasing, manufacturing, development, etc., with a keen insight into the industry's problems for the future.

603. **Engineer**—M.S. in A.E. Aircraft structures engineer, 26 years old, married. Has 2½ years' experience in the design of machine test equipment and 1½ years in responsible position as structures engineer for A.A.F. at Wright Field. Interested in position with Eastern or Midwestern aircraft company, or on staff of Eastern college. Qualified to teach mechanics, strength of materials, and airplane design.

600. **Aeronautical Engineer-Pilot**—Associate in Arts in Ae.E.; Chinese, 23 years of age, single. Cambridge Senior School Certificate (local), London, England. Experienced in layout, structural design, C.A.A. requirements, forging design. Has pilot's license and experience in maintenance of light aircraft and engines. Can translate French and Spanish (speaks both slightly), and speaks English fluently. Now Assistant Stress Analyst to Staff Engineer in well-known aircraft company. Desires engineering work with aviation company outside the United States. Willing to teach elementary engineering subjects. Will consider sales offer. Photograph, certificates sent on request.

599. **Engineering or Management Executive**—Engineer with 26 years' experience in aircraft engineering and manufacturing seeks responsible engineering or management connection with aircraft manufacturer. Previous positions in $12,000 range. Outstanding design, organizing, and managing ability. Familiar with Army, Navy, and commercial requirements.

596. **Technical Editor-Writer**—Graduate Mechanical Engineer. Has 1 year's experience in operation of low-turbulence wind-tunnel testing airfoils, flaps, and ailerons. Also has 4 years' experience writing and editing technical training material consisting of description, operation, inspection, maintenance, and test of airplane engine, flight, and navigation instruments. Desires position as editor-writer of technical material.

594. **Pilot-Engineer**—Degrees in both Aeronautical and Mechanical Engineering. Three years' experience in flight test engineering and 1 year in wind-tunnel testing. Experience in both performance and flying qualities flight-test methods. Commercial pilot with single and multi-engined land ratings. Total time 1,700 hours with majority military in wide variety of types. Interested in flying or combination of flying and engineering in Middle West or West Coast aircraft company, preferably in connection with commercial-type aircraft.

590. **Salesman**—Age 26. Education in Eastern preparatory school and university. Three years' air-line engineering, domestic. Desires position in aircraft sales (airplanes and/or airplane parts). Excellent personal and business contacts.

589. **Representative**—Chinese, technical engineer with degrees in Ae.E. and M.E. Completed Army Air Forces A. and E. maintenance and pilot training. 3 years' factory experience in aircraft engine development works includes 1 year of jet propulsion and gas turbine. Formerly Government official. Desires responsible engineering position or representation to China.

588. **Management or Administration**—Twenty-seven years old, single, A.B. degree, University of Pennsylvania. Major in political administration, courses applicable to business administration. Courses in industrial engineering including industrial relations, business and government, organization and organizational structure. Aeronautical engineering courses in elementary aerodynamics, performance calculation, aircraft drafting and engineering. Two and one-half years in aircraft testing in present position. Desires permanent position on junior level in management or administration with opportunity for advancement. Philadelphia area.

587. **Aeronautical Engineer**—B.S. in Aeronautical and Mechanical Engineering. Five years' experience as aircraft service engineer, including overhaul, manufacturing, and aircraft modification. Ex-Marine Captain. New York area preferred.

580. **Engineer**—E.E. Seeks research, development, or administrative position in New York City or Long Island. Ten years' experience includes aircraft controls, ignition, servomechanisms and industrial electronics. Qualified to hold position requiring considerable administrative or supervisory ability. Will accept position of lesser responsibility with reasonable assurance of advancement.

578. **Aeronautical Engineer**—B.S. in M.E., aeronautical option, 1942. Four years' experience large-scale wind-tunnel testing and research work on propellers, air-cooled engine installation, airplane stability and control and general aerodynamics. Now engaged in supersonic flight-test work. Desires position in Middle West. Prefers research and development work in high-speed aerodynamics.

Progress Report on Hagan THRUSTORQ

The first announcement of Hagan THRUSTORQ appeared late in 1945.

At that time Hagan THRUSTORQ was already in service in major airplane and automobile engine factories. They were being used for the measurement of torque of standard horizontal engines and of vertical helicopter engines, and the thrust of jet engines.

Since then the use of THRUSTORQ in these fields has increased greatly. More companies have been added to the list of users; more THRUSTORQS have been placed in service by the companies using them; new uses for THRUSTORQ have been developed.

VARIED APPLICATIONS

THRUSTORQS are used today not only for these original purposes and for such allied applications as measuring the thrust of intermittent jet engines (in rockets and buzz bombs, for example) but they are also employed in connection with tests of chassis, valves, bearings and piston rings; in the weighing of liquids; and in many other ways.

MEASURES WITH *AIR*

Hagan THRUSTORQ measures force by automatic application of a measured pneumatic pressure on a precision flexible diaphragm. The measurement is accomplished by no movement of the measured system. This null displacement feature has already made possible the development of several new types of testing machines by users.

Pressures can be registered on a manometer, or gauges may be calibrated to give readings directly in foot-pounds. The location of any gauge or recording device is determined *solely by convenience.*

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1946 AERONAUTICAL ENGINEERING CATALOG

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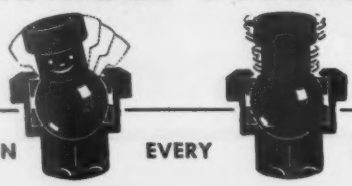

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